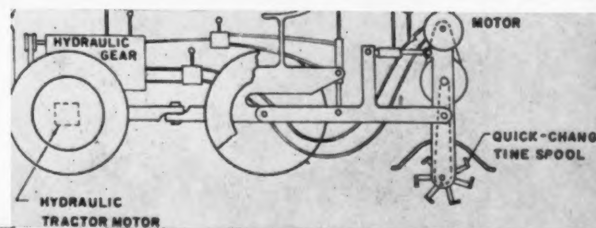
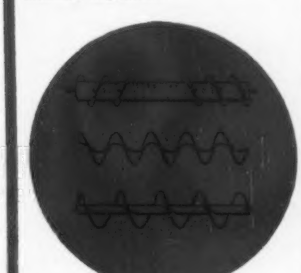
OCTOBER 1959

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers





Agricultural Engineering

Established 1920

CONTENTS • OCTOBER, 1959 • Vol. 40, No. 10

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JAMES BASSELMAN, *Editor and Publisher*

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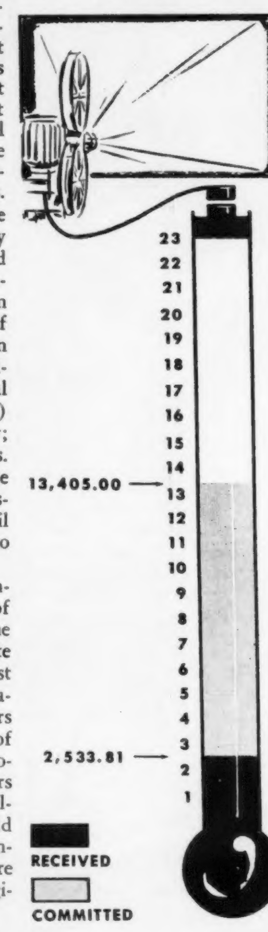
Motion Picture Progressometer

COLLEGE enrollments in agricultural engineering have not kept pace with the expanding demand for the services of agricultural engineering graduates. The ASAE personnel service is now experiencing the most active demand for agricultural engineers since it came into being some fourteen years ago. Industrial employers in particular are expressing a desire for engineers that is unprecedented in ASAE history. More and more rural industries are putting in bids for the services of engineers. The trend to better engineered products and procedures is a reflection of our times, and the trend is irreversible.

But the short supply of qualified agricultural engineers threatens to jam the gears of progress. Around 350 ASAE members are lost each year due to retirement, death, or "backsliding" to other areas of activity. This is approximately equal to the number of agricultural engineers who graduate each year. Thus there is *no* increased enrollment to meet the mounting demands of industries expanding their engineering staffs, of rural industries now recognizing the importance of engineering to their operations, of public service agencies with increased research, extension and teaching responsibilities, to mention a few.

These facts were recognized by the ASAE members who, several years ago, expressed the need for a public relations program designed to acquaint high school students possessing aptitudes and an interest in agriculture with the challenges and opportunities offered by the profession of agricultural engineering. First among the proposed activities was the production of a motion picture which would briefly but accurately present the story of agricultural engineering — its importance, what it includes, what its graduates do. From this foundation, an effective, yet low-cost program to acquaint the public with the agricultural engineering profession could be inaugurated by ASAE, its sections, and individual members.



The picture will soon become a reality. Filming is under way and copies have been promised by June 1960. Funds to support costs are anticipated from four major sources, all of which have a vital stake in agricultural engineering enrollment: (1) college agricultural engineering departments; (2) ASAE sections; (3) industry; and (4) selected individuals. Commitments received to date have been sufficiently impressive to warrant ASAE Council to authorize the producer to proceed with production.

The thermometer will be employed to keep you informed of the progress toward raising the necessary funds to complete this project. This is the first activity undertaken by the national Society in many years which involves the raising of funds outside the regular Society budget and headquarters operation. The successful culmination of the project should generate a "pride of accomplishment" among all who are genuinely interested in engineering for agriculture.

Report to Readers . . .

CLINGING-VINE-TYPE POTATO IS KEY TO SEARCH FOR PERFECT HARVESTER

Along with the search for the perfect potato harvester, plant breeders have been working to produce tubers that separate from the vines as quickly and cleanly as possible. Now NIAE researchers in England see the problem in a different light. They say, why lift part of the field and then separate soil and potatoes from it? They are asking plant breeders to develop strains of potatoes that will cling to the vines so that the whole plant can be lifted out of the ground mechanically and the tubers stripped off the vines by machine. Some progress has already been made toward this goal, and the newest prototype harvester is in production by a British manufacturer. . . . . NIAE has already modified a peanut-harvesting machine to harvest potatoes. It is driven by the tractor power take-off and has hydraulic steering and depth control. It lifts one row at a time, and a share runs beneath the row while two skeleton feeler arms guide and divide the growth of vines. The vines, bunched and guided into the lifting conveyor, are then gripped by a tongue-and-groove rubber belt which carries them upward for stripping. Stripping is done by two metal arms; the vines are carried back over the machine, and the potatoes fall onto a side conveyor and elevator for loading. Two men are required to operate this equipment, one on the tractor and the other on the harvester.

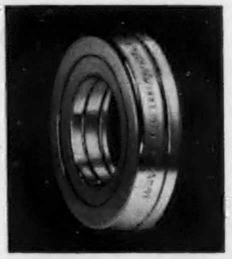
ENGINEERS STUDY TRAFFIC CONTROL FOR COWS IN LARGE-SCALE DAIRIES

Present trend to much larger dairy-production units, influenced by the formation of more and more cow pools, is creating some difficult methods-engineering problems for agricultural engineers. One of these is traffic control, getting the several hundred cows, in some of the larger dairies, for example, to and from milking parlors with a minimum of congestion. The problem is one that calls loudly for solution. . . . . So important is the need for comprehensive methods-engineering studies that the USDA and the University of California have had a team of agricultural engineers at work to study the problem and determine the engineering improvements needed to assure efficient production in these larger dairies. Engineered methods and equipment that result in high labor efficiency are a must for the dairyman who intends to stay in business. . . . . One important angle of the problem is operator fatigue. In the case of a 960-cow California dairy, three-year records showed that the herd could produce more milk and be milked faster and with less labor in elevated rather than in floor-level stalls. Differences in production were due largely to extra care given the cows in elevated stalls by milkers who were not as tired for the reason that they did not have to squat or stoop. The engineers report that the production difference, in this particular case, between the two systems was sufficient for the new system to pay for itself in less than a year through the additional milk the cows produced.

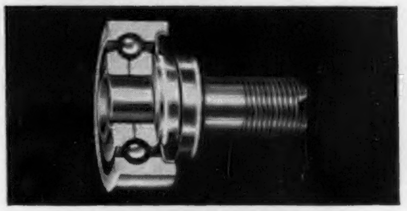
MECHANICAL TOMATO HARVESTING LIKELY WITHIN NEXT TWO YEARS

That was the prognostication last month of a Michigan AES research team (an agricultural engineer and a horticulturist), following field tests of an experimental harvester in the home county of this publication. Chief present obstacle to achieving success in mechanical harvesting is the tomato plant itself. The researchers say they will have the machine ready as soon as they get the plant they need. . . . . A dwarf-type tomato plant, one that ripens virtually all of its fruit in time for the one picking, is a requirement of satisfactory mechanical harvesting. Indiana (Purdue) AES researchers say they now have dwarf varieties that will ripen up to 90 percent of the fruit at one time. . . . . A number of changes and refinements in the Michigan harvester are to be made as testing operations are continued into the fall and winter in a special plastic greenhouse. A number of machinery manufacturers are said to have been following closely the development of the tomato picker, and are in fact engaging in experimental work of their own.

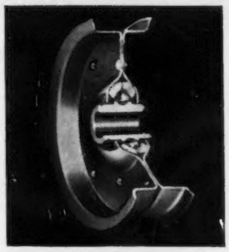
(Continued on page 584)



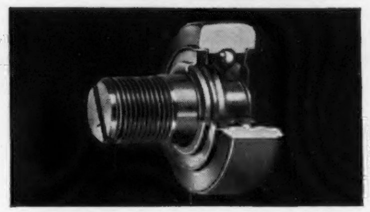
Clutch Bearings



Hay Rake Bearings



Idler Pulley Assemblies



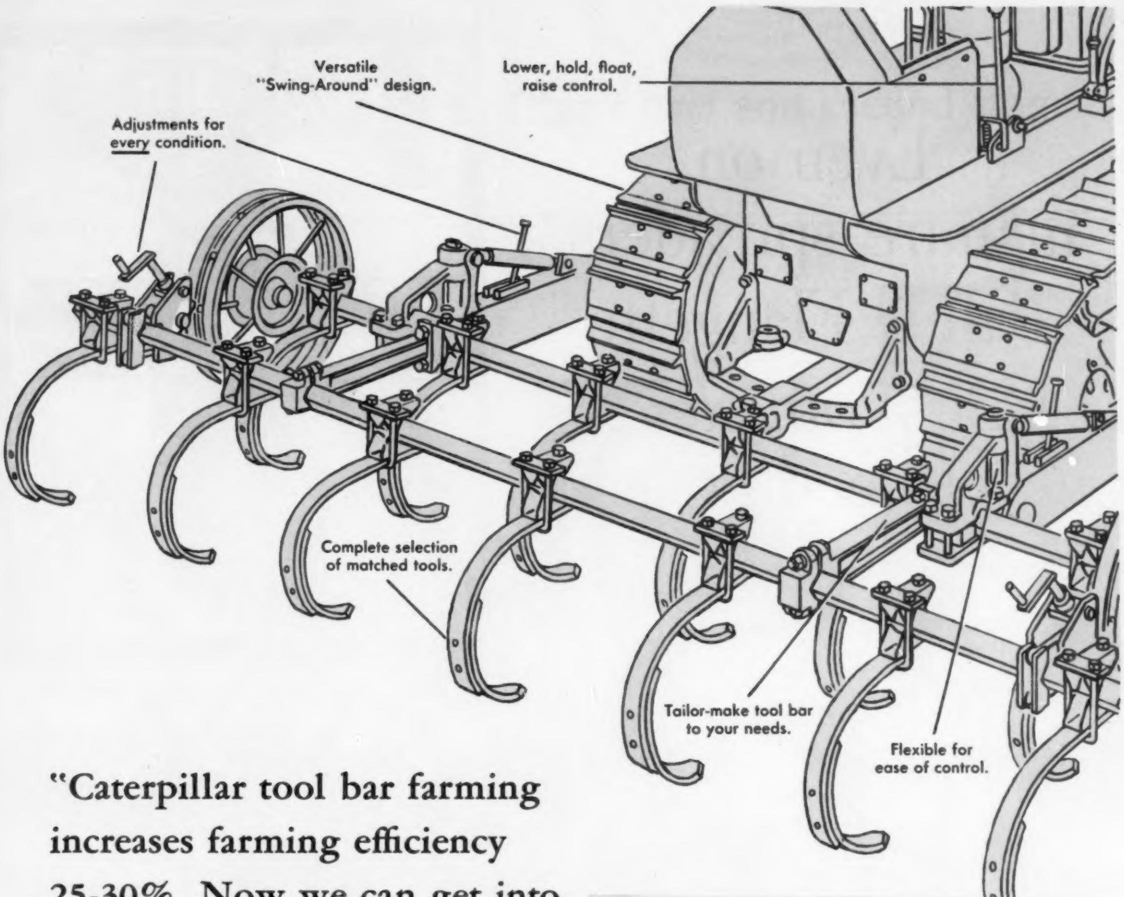
Plunger Rollers

ORCHARD FROST PROTECTION WITH UNDER-TREE-TYPE WIND MACHINES Frost-protection research studies by California AES agricultural engineers show that the air jet from tower-mounted wind machines, which raises orchard temperatures by the forced mixing of cold orchard air with the warmer air overhead, has difficulty in penetrating the canopy of intertwining branches of adjacent trees. This accounts for most of the frost damage occurring in the lower parts of the trees. . . . . During last winter these engineers began investigating the under-tree-type wind machine to determine if it might be directly effective in preventing air stratification that may lead to frost damage in the lower parts of the trees. Since air movement under the tree canopy is much stronger with the under-tree unit, they believe further tests will show it to be more effective in redistributing the heat from a few scattered orchard heaters. . . . . As a further observation, the engineers say that the addition of a large amount of heat from the burners on the low-mounted unit causes the air jet to lift out of the orchard, and for that reason the additional temperature gain in close to the machine does not seem to be worth the cost of burner equipment and propane fuel.

ENGINEERS' RESEARCH DREAM MAY BE ABOUT TO COME TRUE For many years engineers have dreamed of generating electricity by means of a fuel cell or battery that generates electric current from the reaction of gases, such as hydrogen and oxygen, that are fed into it. It is now reported that a British scientist has broken this technological barrier by developing a practical fuel cell, after working on it for more than 20 years. This cell operates on hydrogen and oxygen at a pressure of 400 psi and at a temperature just under 400 F. A second type of cell, however, is being developed that will run on any combustible gas at atmospheric pressure and use air rather than pure oxygen as the oxidizer. . . . . The efficiency of the new cell's production of electricity is considered high. A reduction in volume of control equipment is a main requirement of future development - one-fifth to one-tenth the present size is believed to be ultimately possible.

PLASTIC FILM SOLVES SOME IRRIGATION DITCH PROBLEMS The California agricultural extension service reports satisfactory results in the use of plastic film liners for such irrigation ditch problems as seepage, weeds, and erosion. Black polyethylene film was used. For most conditions, a 4-mil-thick film was found to provide satisfactory control in connection with specific ditch problems for periods as long as three years. Ordinarily films thinner than 4 mil would not last more than one year. . . . . Careful preparation of the ditch was found to be necessary prior to installing the film. Sharp weed stalks, large clods, etc, had to be removed, and it seemed best to place a layer of soil under the film in rocky soils. By working the soil in the ditch well and installing the lining immediately following construction, extra ditch preparation could be reduced to a minimum.

FRONT-WHEEL BRAKES FOR TRACTORS A SAFETY FACTOR IN HILL FARMING Especially in areas where considerable hill farming is practiced, as in New York state, for example, tractors equipped with front-wheel braking systems would often have definite advantages over those not so equipped. Most important of these is safety of the operator. A second advantage would be to increase the tractor's usefulness. . . . . Cornell agricultural engineers, who have been conducting research studies on this problem, point out that four-wheel braking would be especially effective in helping to prevent sliding and jackknifing of tractor outfits when descending steep grades. . . . . In the Cornell tests, hydraulic brakes were chosen and the master cylinder was located on the right side of the tractor. The brake backing plate was mounted on bearings on the spindle so the braking force would cause compression in the vertical link behind the front leg of the tractor. This compression could be measured and from it the braking force between the tire and surface calculated.



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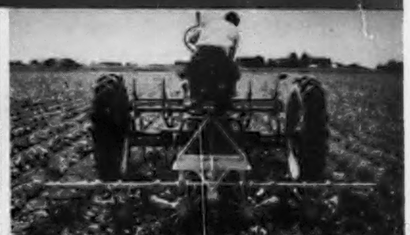

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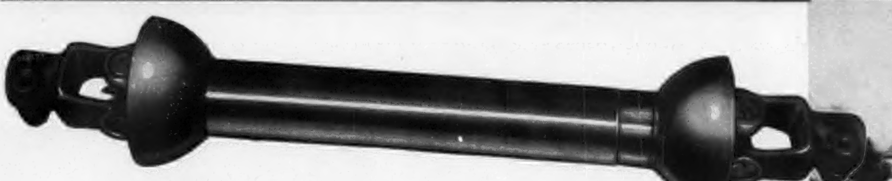

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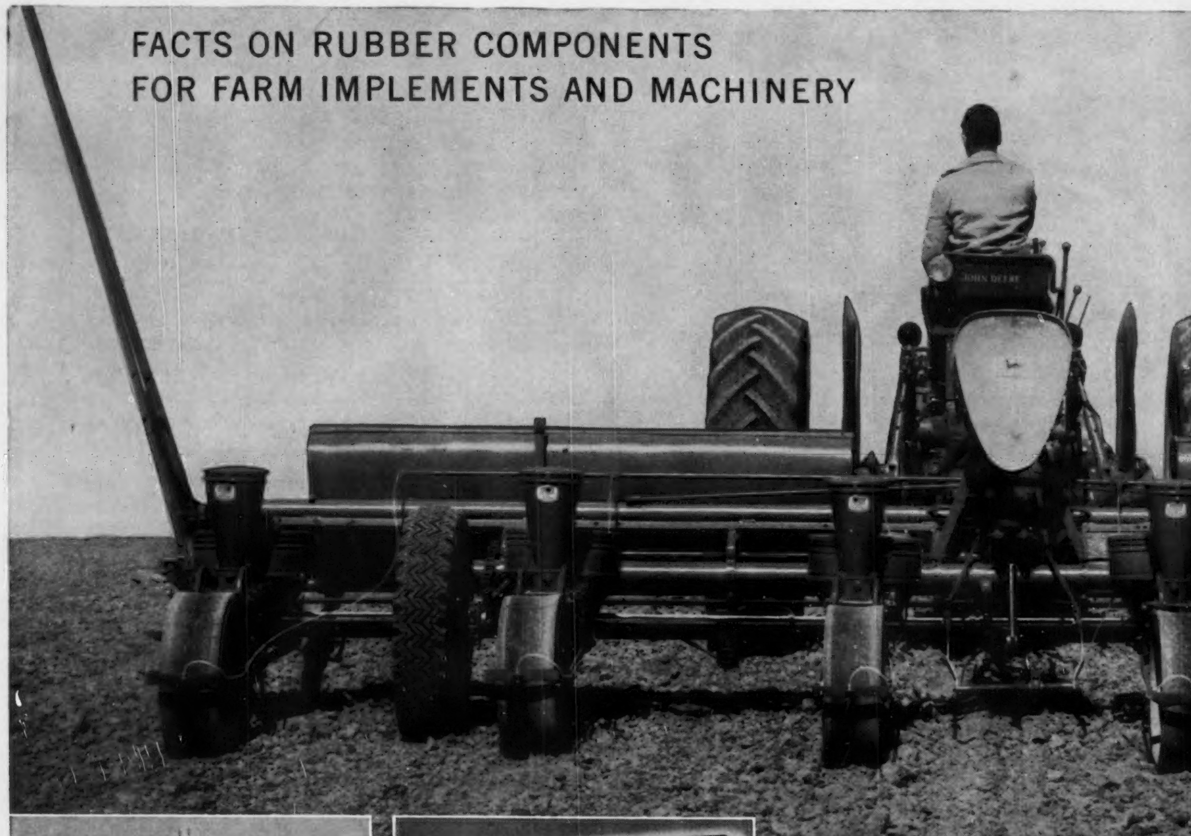
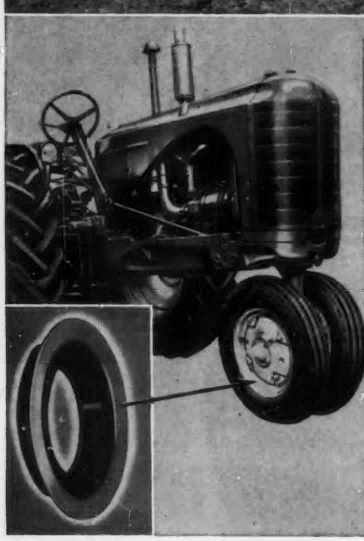
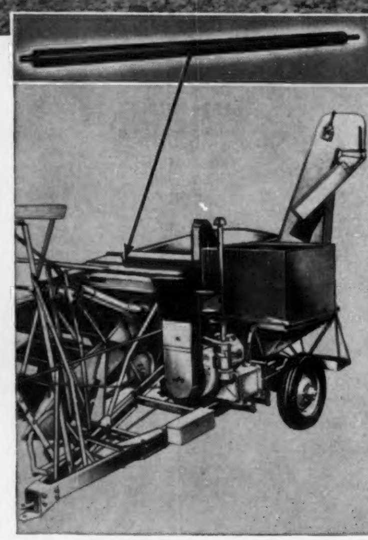
FACTS ON RUBBER COMPONENTS FOR FARM IMPLEMENTS AND MACHINERY

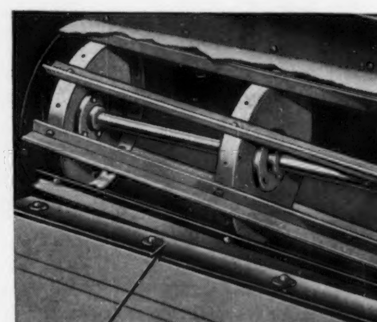




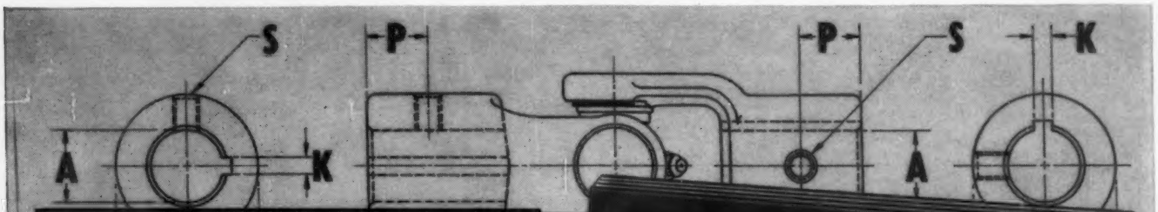
"Orcotite" Dust Seals, developed especially for farm equipment, protect wheel bearings from dust, dirt and grit. The cushion-seal, bonded-to-metal cap adjusts itself automatically for excessive wear and end play.



Draper Apron Roller, still another rubber bonded-to-metal application designed specifically for farm equipment, prevents slippage of the draper apron used for carrying grain from the sickle platform to beaters.



Cylinder Bar is a rubber bonded-to-metal component used in the threshing mechanism of a modern combine. The rubber-faced, steel cylinder bar operates in connection with a rubber stripping plate and two stationary block concaves. Hard and soft shell crops are protected against damage due to excessive crushing.



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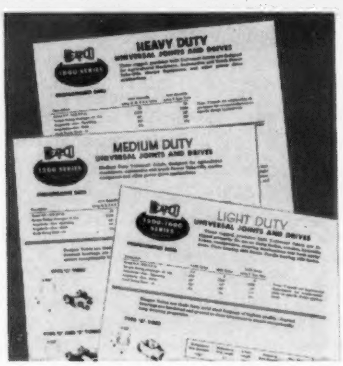
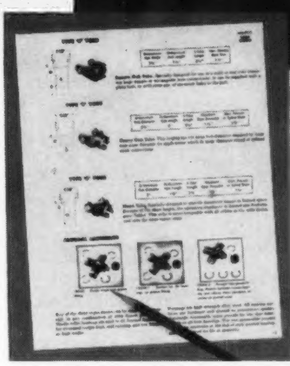


For convenience, the Catalog is arranged by Sections ... Light duty, Medium duty, Heavy duty. These Sections are also available individually.



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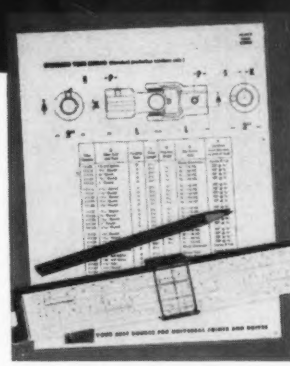

Each Section contains a table of standard production numbers (listing all data on bore sizes, lengths, keyways, setscrews, etc.).

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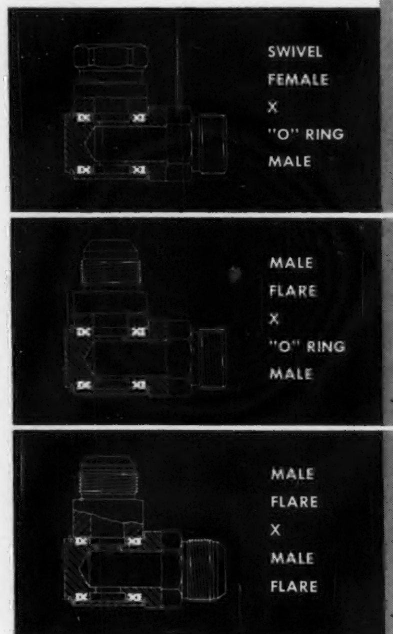

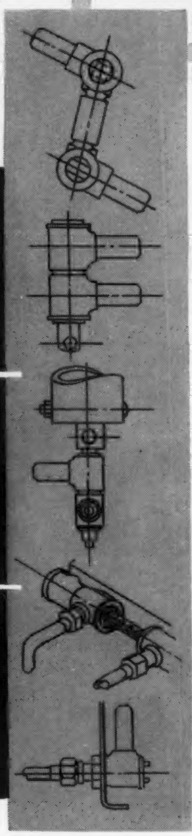

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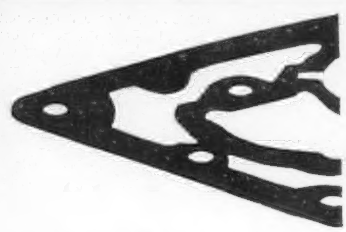

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K3

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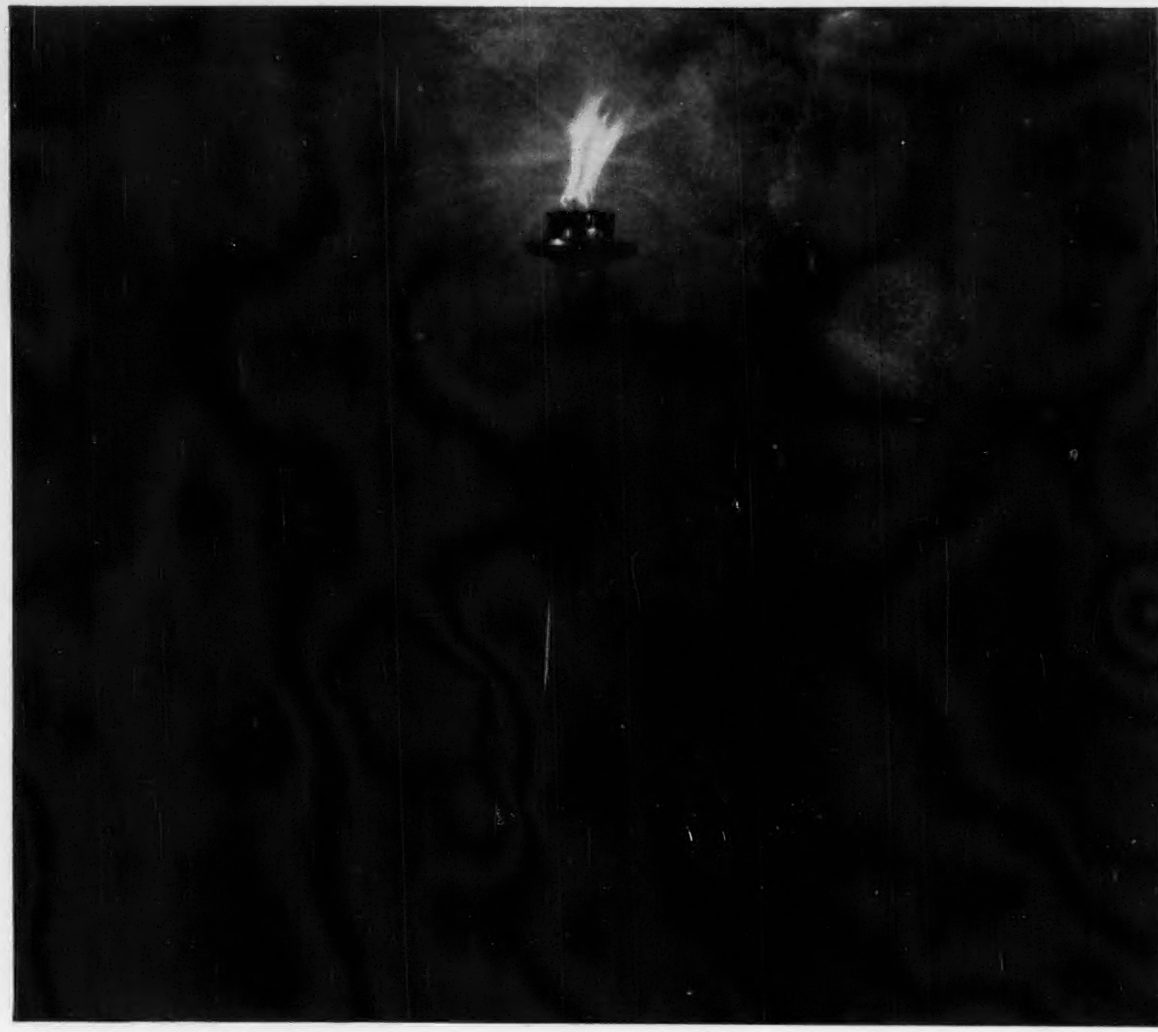

Agricultural Engineering

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James Basselman, *Editor*

RESEARCH CHALLENGE TO AGRICULTURAL ENGINEERS

ALTHOUGH the American Society of Agricultural Engineers has been organized as a group of agricultural scientists for only about 50 years, it may well represent the most ancient of man's scientific efforts.

When our ancestor knocked the corners off a flat stone and found that he could transport his belongings by wheel, he made an engineering discovery that has since been hailed as one of the greatest of all time. From prehistory to the present, agricultural engineers, whether called by that or some other name, have been discovering, inventing, and developing ways and means to improve the efficiency of farming and the welfare of farm families.

Because of research in all the agricultural sciences—and the technology arising from it—American agriculture today is probably the most efficient in the world. Fewer farmers, using about the same acreage, are producing more than half again as much as they produced just 20 years ago.

In view of present farm surpluses, our greatest need right now is to find wider outlets for farm commodities, especially in industry. This task includes not only finding new uses, but also developing new techniques for producing farm commodities, at costs that will permit their sale at prices competitive with other industrial raw materials.

But in addition to expanding markets for today's abundant production, we must also think of the future, when our big problem will be to produce enough.

The U.S. Census Bureau estimates that 50 years from now — by the year 2010—we may well have 370 million people, more than twice the population we have today. This means that just to maintain our present diet levels, we will require at least twice as much food and other farm products as we are consuming now.

BYRON T. SHAW
Administrator, Agricultural Research Service, U.S. Department of Agriculture

At the same time, the amount of farmland available is not likely to be increased much beyond the acreage farmers are using today. Trends also indicate that our farms will continue to increase in size and decrease in numbers, and that additional farm workers will seek part or full-time employment in towns and cities.

It is easy to see the tremendous challenge we face in agricultural research. It will be our job to provide the scientific technology whereby American farmers, with only a little more land and considerably less manpower, can, in only 50 years, double present output which has taken 300 years to achieve.

To meet this challenge, I believe that we must give more emphasis to fundamental research. We have solved many agricultural problems by applying established scientific principles—with a small amount of new basic research here and there. But we have also failed in many instances, because we haven't had the basic knowledge on which we could build firmly and securely. I believe this is true in all areas of agricultural research, including agricultural engineering.

Traditionally, agricultural engineering research has been largely in the applied field. You have been the ones who have had to take the results obtained in other fields of science and translate them into workable designs or plans that could be used by farmers or farm-related industries. Over the years, you have developed power and equipment to take the place of horses and men. You have helped to put fertilizers, formula feeds, and pesticides on every farm in the country. You have designed drainage and irrigation systems, structures, and other farming aids to fit the larger, more specialized operations carried on by modern farmers. And you have developed storage, processing, and marketing facilities that have helped to maintain the quality of agricultural products and to distribute them more efficiently from farms to consumers.

This is a record to be proud of—and to be continued. The time will never come when physical and biological scientists can get along without engineering scientists. I can think of no field of agricultural research or development that does not require your cooperation either in the research itself or in its application.

Fortunately, through the years, some of you have gone beyond the development of application and testing techniques. You have followed in the footsteps of men like Michael Faraday and Joseph Henry. In a day when conventional research on illumination may have involved developing better lamp wicks or brighter burning whale oil, these men charted their own intellectual course, and discovered the principles of electromagnetic induction. It is this kind of pioneering research that has been the starting point for most of the scientific advances made in agriculture and elsewhere. It is the kind of research that offers the greatest challenge and the greatest promise today. And the challenge applies to engineers just as it does to all the other scientists working in agriculture.

I believe that we must take a broader and deeper approach to the engineering problems facing farmers in their efforts

(Continued on page 616)

An address before the 52nd Annual Meeting of the American Society of Agricultural Engineers at Cornell University, Ithaca, N. Y., June 1959.

Rotary Tiller in Soil Preparation

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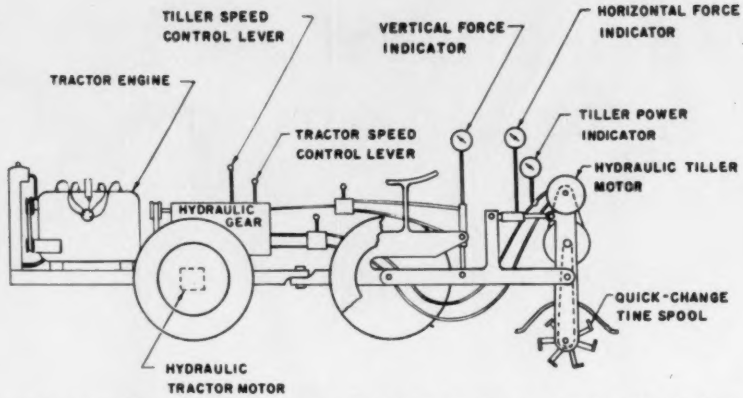


Fig. 1 Schematic of hydraulically controlled and actuated research tiller. Variable-speed wheel and rotor drives and rotor supported with two degrees of freedom, easily and quickly permits quantitatively determining traction and rotor horsepower, horizontal and vertical rotor forces over a wide range of conditions

Research leads to improving performance characteristics of rotary tiller tines

ROTARY tillage is having a tremendous impact on power gardening. Though an old art, the widespread use of rotary tillers in this country is a fairly recent development.

Patents on rotary tillers were issued as long ago as 1850, but a successful device was not developed until about 1910 in Switzerland. The first machines were introduced into the United States by Swiss manufacturers about 1930. Shortly after this, several American companies started manufacturing rotary tillers, the greatest growth occurring after World War II.

Though many types of rotary tillers, especially the two-wheeled type, are now available, the development in this country has evolved largely from trial-and-error methods, rather than technical analysis or quantitative experimentation. As a consequence, relatively little fundamental information is available on performance characteristics, the influence of the many variables that can contribute to the acceptance of rotary tillage, and the approach to optimum design.

Criticism of rotary tillage for soil preparation is concerned most generally with its relatively high horsepower requirement and the tendency to overwork the soil. Many of the earlier tillers rather violently agitated the soil, resulting in the lighter constituents, mostly clay, being left on the surface. The later rains or irrigation turned the surface into a hard, impenetrable crust.

Objective and Scope

The principal objectives of this initial research and testing program were to: *(a)* Determine and compare the performance characteristics of present types of rotary-tiller tines designed to operate in conjunction with a horizontal rotating shaft mounted transverse to the direction of travel, and *(b)* initiate work directed towards optimizing future design for improved performance characteristics.

Paper presented at the Annual Meeting of the American Society of Agricultural Engineers at Santa Barbara, Calif., June 1958, on a program arranged by the Power and Machinery Division.

The authors — W. J. Adams, Jr. and Donn B. Furlong — are, respectively, assistant manager, central engineering department, and chief development engineer, Bolens Products Division, Food Machinery and Chemical Corp.

The scope of this program included the determination and comparison of the following performance characteristics of three basic types of tines, namely, hoe, slicer, and pick. For each tine type, the following factors were varied, one at a time, through the ranges indicated:

Rotor speed	400 to 1,000 fpm
Rotor width	12 to 24 in.
Increment of cut	2 to 6 in.
Depth of cut	2 to 6 in.
Hardness of ground	Dry to moist
Tine-rake angle	10 to 30 deg

The influence of these factors was measured and recorded in the following terms:

Rotor horsepower
Rotor reaction forces, vertical and horizontal components
Dispersion of surface organic matter
Pulverization of the soil
Sub-soil condition

Due to the variable nature of soil conditions, great emphasis was placed upon a research method that would permit changing the various factors influencing performance quickly, so that a series of tests could be run in a very short period of time.

Test Equipment

A hydraulically controlled and actuated rubber-tired research vehicle was used as the basic unit to which the test tiller mechanism was mounted as illustrated schematically in Fig. 1. The wheels of the vehicle were driven by means of an infinitely-variable-displacement, engine-driven hydraulic pump and fixed-displacement motors on the wheels. A second engine-driven, variable-displacement pump powered a fixed-displacement hydraulic motor, which drove the rotor assembly of the tiller through a double-reduction chain drive. Due to the large wheelbase and tread width of the unit, stable testing conditions were available.

Fig. 2 *(Left)* Left rear view of research vehicle and rotary tiller. Its versatility and flexibility permitted running tests over a wide range of conditions within a short time to keep variations in soil conditions to a minimum • Fig. 3 *(Right)* Partial view of 10-acre test plot. This plot was selected for its uniformity of soil structure, flatness, and surface residue. Note untilled strips between test runs to eliminate possibility of overlap error of successive runs

The tiller framework, hinged from the rear axle, supported the rotor housing which was free to pivot also about a transverse axis to give the rotor assembly two degrees of freedom, horizontal and vertical. The vertical degree of freedom was restrained by a hydraulic cylinder between the vehicle and tiller frame. This cylinder not only was used to regulate the depth of cut, but also was used to restrain the horizontal movement of the rotor assembly, and this likewise was gauged and calibrated to read the net horizontal force in pounds.

Tachometers were installed to measure tiller rotor speed which, together with gauges measuring pressure drop across the rotor-drive motor circuit, permitted the determination of horsepower input to the rotor assembly. Tachometers were installed on the traction-drive motors to measure ground speed from which traction horsepower was calculated.

Fig. 2 shows a photograph of the instrumented research vehicle and rear-mounted tiller test unit.

Testing Area

A test plot of approximately ten acres was selected on the basis of its uniformity of ground conditions as far as hardness, moisture content, flatness, organic surface matter, etc., were concerned. The soil is classified as Sorrento silt loam. The majority of the tests recorded in this paper were made under conditions when the soil was dry. As will be shown subsequently, a series of tests were run after the rainy season set in to show the influence of moisture. Emphasis was placed on maintaining uniformity of hardness of the soil during a given series of comparative tests.

Testing Procedure

The following sequence was established for the testing procedure: The test runs were from 10 to 40 ft in length. Readings were not taken until the conditions reached steady state. Each tine was tested at three peripheral speeds, of 400, 700 and 1,000 fpm, with progressive increments of cut from 2 to 6 in. In addition, some tests were conducted with varying rotor widths. Untilled strips were left between successive test runs to eliminate the possibility of overlap errors. Fig. 3 illustrates the test plot and Fig. 4 shows how the cross section was examined for each test strip to establish the dispersion and pulverization characteristics as well as the condition of the tilled sub-soil. These dispersion and pulverization characteristics were analyzed and evaluated by the test engineer.

Readings were taken on rotor motor pressure drop, rotor speed, tractor ground speed, horizontal-force cylinder pressure drop, vertical-cylinder pressure drop, and the visual analysis of the tilled bed.

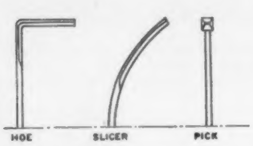
To insure the best possible data interpretation, the information for a series of tests was plotted graphically and corresponding curves were made through each progressive

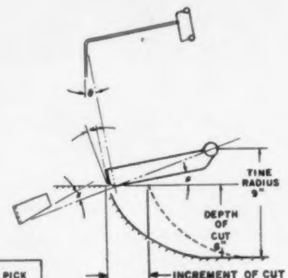
Fig. 4 This view illustrates how each test run was examined to establish dispersion and pulverization characteristics as well as the condition of the tilled subsoil

test point. Any point out of line was weighed in the entire group of points, which resulted in a curve representing the best mean values. In general, enough points were taken so that obvious erroneous values had little effect on the over-all results.

Types of Tines Tested

The upper left-hand portion of Fig. 5 illustrates the three basic types of tines tested. These tines are defined in some detail by the rake, approach, sweepback, and bend angles as illustrated and tabulated. Note that the approach angle varies with the depth of cut. Values shown are for 6-in. depth.





ANGLE	TITLE	HOE	SLICER	PICK
α	RAKE	15°	—	25°
β	APPROACH	-25°	-20°	—
γ	SWEEP-BACK	20°	45°	—
θ	BEND	5°	—	—

Fig. 5 Characteristic tine types and representative ground engagement angles. ***(Upper left)*** **The three basic types of tines tested.** ***(Lower left)*** **The table shows the important ground engagement angles which are defined by the three-projection sketch to the right. Increment of cut is defined in footnote below**

Power Characteristics

For the purposes of this paper, the detailed results of a typical hoe-shaped tine on the performance characteristics only are shown. Fig. 6 illustrates the effect of rotor peripheral or tip speed on rotor horsepower for a given depth of cut, width of cut, rate of tilled volume covered, and soil condition. This illustrates the marked influence rotor tip speed has on power requirements, even though a constant volume of ground has been tilled. This effect alone justifies the trend toward lower rotor speeds.

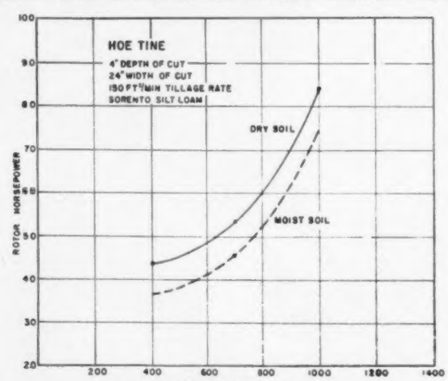


Fig. 6 These curves show the effect of tine-tip speed or rotor horsepower for dry and moist soil with all other conditions of depth, rate of tilled area covered, and width of cut held constant

The effect of increment of cut* on rotor and traction horsepower is illustrated in Fig. 7. It is interesting to note

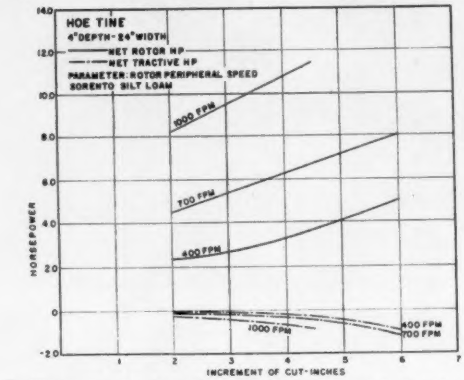


Fig 7 These curves show the effect of increment of cut on rotor and traction horsepower for three tine-tip speeds, considered to be high, intermediate and low

that, contrary to theory, rotor horsepower does not increase proportionately with an increase in increment of cut. For example, doubling the increment of cut, for a given rotor tip speed, doubles the volume of ground tilled; but it will be noted that the rotor power input is increased only about 50 percent. This effect suggests increasing the increment of cut, limited only by the degree of pulverization desired and, of course, the strength, weight, and balance of the component machinery.

The influence of rotor width on the horsepower requirements is illustrated in Fig. 8. Contrary to theory and in the

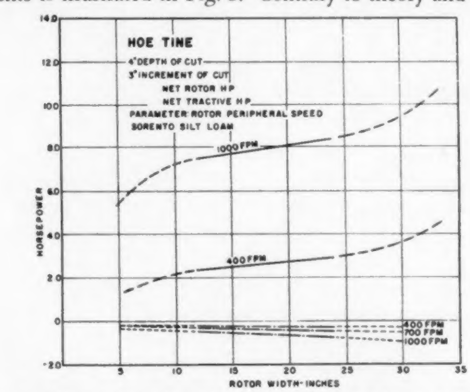


Fig. 8 These curves show the effect of rotor width on horsepower. The apparent influence of "edge" or "end" effect of the rotor suggests using wider rotors

range tested, rotor and traction horsepower do not increase proportionately with rotor width. This indicates that the "edge" or "end" effect of the tines has a marked influence on power. Theoretically, horsepower should be zero at zero rotor width. Also, as the width is greatly increased, the "edge" effect diminishes so the slope of the curve should pass through zero. The dotted line portions of the curves were added to illustrate the theoretical. This width characteristic suggests that, with due consideration for usage such as crop row width, available horsepower, etc., the rotor

*Defined as the horizontal distance, measured at the soil surface, between the initial contact point of one tine and the same point of each subsequent tine as it engages the soil in the same path of cut (Fig. 5).

assembly should be widened for best utilization of power.

The effect of soil types on power requirements is graphically illustrated by Fig. 9. The abscissa of this curve was

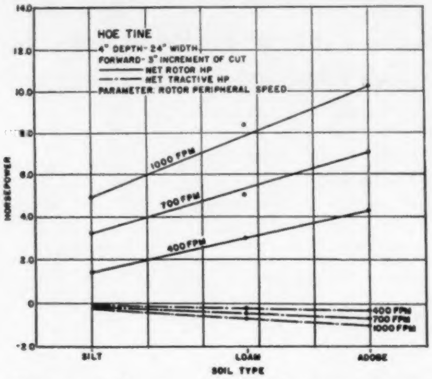


Fig. 9 Abscissa of the curve is an arbitrary scale to graphically show how rotor and traction horsepowers are increased when varying from the lighter silt soils on the left to the heavier clay and adobe soils on the right

taken arbitrarily to illustrate the influence on power ranging from the lighter, silt-type soils on the left to the heavier adobe soils on the right. Here again the influence of the slower rotor-tip speeds for the best power utilization is evident.

Pulverization

The effect of rotor-tip speed on pulverization is illustrated in Fig. 10 where all factors, including increment of cut, are held constant for each curve. Apparently shattering of the soil when dry, due to impact at the higher tip speeds, is one of the causes for the marked reduction in average lump diameter of the soil as rotor speed is increased. Another possible explanation for this is that, due to the higher rotating speeds, more of the soil is recirculated within the rotor assembly, resulting in more cutting cycles to a given piece of ground. Also, the higher rotor speeds throw the soil up to impact the underside of the hood, resulting in additional fracturing. The curves also serve to demonstrate that there is a diminishing return on the degree of pulverization with decreasing increments of cut. This effect, together with the influence of larger increments of cut on input horsepower, suggests using lower to intermediate increments of cut at the lower-rotor peripheral speed.

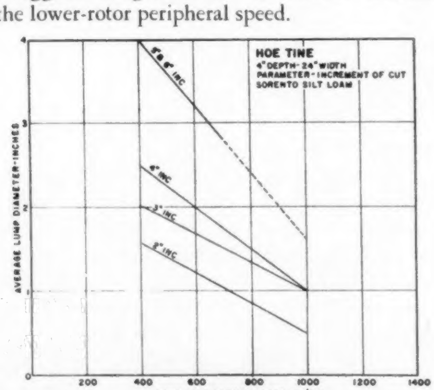


Fig. 10 These curves show how increasing rotor or tine-tip speed increases pulverization (reduces lump size) even though increment of cut is held constant

The influence of depth of cut on pulverization is illustrated in Fig. 11. Increasing the depth of cut reduces the

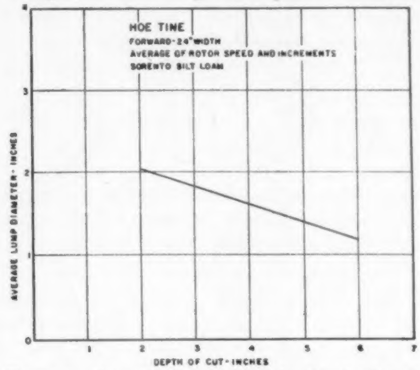


Fig. 11 This curve shows how increasing the depth of cut increases pulverization, even though the size of the slice becomes greater

average lump diameter. This phenomenon is contrary to the theoretical size of the slice, which becomes larger in volume as depth increases. More pulverization at greater depths possibly could be explained by the fact that, with the longer tine penetration time, more breaking is done. Also, the larger clumps tend to recirculate more readily in the housing at greater depths, causing additional pulverization.

Comparison of Basic Tines

Although detail data is shown for the hoe tine only, similar data was determined for the slicer and pick tines. Fig. 12 attempts to give an over-all comparison of the three

(Continued on page 607)

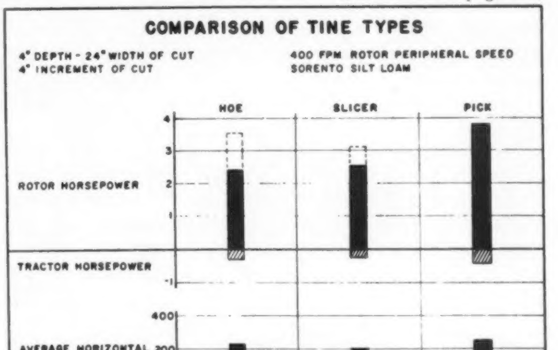


Fig. 12 This chart shows the over-all comparison of the hoe, slicer and pick tines for the standard conditions of low tip speed and intermediate increment and depth of cut. Tests on slicer and pick tines were run to determine complete data similar to that shown in previous curves for the hoe tine

Fiber Glass Filters for Tile Drains

Virgil Overholt
Life Member ASAE

Siltation and rate of discharge from tile lines as affected by reinforced glass fiber material

THE purpose of the tests reported in this paper was to determine the effect of a covering of fiber-glass filtering material on siltation and the rate of flow of water into and discharge from lines of drain tile.

Test plots were arranged consisting of two monolithic reinforced concrete tanks, each 11 by 11 ft by 32 in. deep, inside measurement. A pit between the two tanks, 3 ft wide and 5 ft deep was provided for the metering equipment.

Each tank had three 4-in. tile lines laid 5 in. above the bottom of the tank. The tile were laid to a grade of 0.1 ft per 100 ft. There were nine 12-in. and one 24-in. tile in each line. The upper end of each tile line was capped. The 24-in. length of tile extended through the wall of the tank to provide an outlet into a steel collecting tank for measuring the discharge. There were 10 tile joints in each line through which water and silt could enter. The tile were laid close together, end to end, without crowding or forcing, about as they would be laid in a farmer's field.

The tile lines in each tank were identical, except that for the first, second, and third tests the tile in one tank were wrapped for about 75 percent of the circumference with 12-in. wide fiber glass filter. The tile lines were covered with approximately 2 ft of soil. For the fourth test the filtering material was wrapped completely around the tile lines in one tank.

Soil Used

The soil selected for these tests was a typical fine, sandy soil which has given serious trouble with siltration. For the first two test runs a somewhat finer textured soil was used in one of the two plots. However, one test run with and one without the fiber-glass filter covering was made on each plot. After the first two tests were completed, the soil from both plots was removed and thoroughly mixed. The tanks were then refilled with this mixture for the third test. A mechanical analysis of this soil, after mixing, was made in the soils laboratory at Ohio State University, which gave the following results:

Very coarse sand	0.2 percent
Coarse sand	2.2
Medium sand	29.8
Fine sand	50.6
Very fine sand	8.7
Total sand	91.5 percent
Silt	5.7 percent
Clay	2.8
Total	100.0 percent
Organic Matter	2.2 percent

Paper presented at the Annual Meeting of the American Society of Agricultural Engineers, at Ithaca, N. Y., June 1959, on a program arranged by the Soil and Water Division.

The author — VIRGIL OVERHOLT — is professor emeritus of agricultural engineering, Ohio State University, and consultant, The Hancock Brick and Tile Co.

Soil Particle Size

Very coarse sand	2. - 1.0	mm
Coarse sand	1. - 0.5	
Medium sand	0.5 - 0.25	
Fine sand	0.25 - 0.10	
Very fine sand	0.10 - 0.05	
Silt	0.05 - 0.002	
Clay, less than	0.002 -	

Simulated Rainfall

Simulated rainfall was applied uniformly to the plots by fine nozzles. In order to accelerate the results of these tests, the water was applied to the soil as fast as the soil would take it or the drains remove it. The tanks were filled with soil to within one inch of the top of the tank and the water applied fast enough to produce a slow drip over the edge of the tank.

Each tank was covered with a plastic housing. Heat lamps controlled by thermostats maintained a minimum temperature of 45 F throughout the winter.

Measurement of Tile Discharge

The discharge from the three tile lines in each plot was collected in a steel tank, 12½ in. wide and 24 in. deep by 96 in. long. Each collector tank was discharged by an automatic siphon. Each discharge of the tanks was automatically recorded. This recording device recorded both the number of discharges and the time of each discharge. Each discharge was equal to 8.77 cu ft of water. The sprinklers were occasionally turned off for a few days to permit aeration of the soil.

Reversing the Plots

After each test the tile lines were removed and relaid, and the fiber-glass filter was changed to the opposite tank. At the time of the second change, all the soil was removed from both tanks. The soil was placed on a single pile and thoroughly remixed to insure uniformity of soil in both tanks for the third test.

Measurement of Silt

The measurement of silt entering the tile lines was more difficult than measuring the discharge of water. It was originally intended to measure the silt collected in the tile lines and that discharged with the water. Since these tile lines were only 11 ft long and the grade only 0.10 percent, it was found that only a trace of silt left the tile with the water. Since this loss was not significant, it was ignored.

Each time the tile lines were changed the silt was carefully removed from the tile and dried to constant weight. The results were recorded in grams. The silt from each plot was weighed separately.

TABLE 1. RELATIVE RATE OF SILT ACCUMULATION IN EXPERIMENTAL TILE LINES

(Fiber-glass filter 12 in. wide was used in tests Nos. 1, 2 and 3. Silt used in fiber-glass-protected tile as unity)

Test run No.	Tile lines with fiber-glass filter	Tile lines without fiber-glass filter
1	Coarse-textured soil 1	Finer-textured soil 7.69
2	Finer-textured soil 1	Coarse-textured soil 0.93
3	Soil texture same in both plots 1	Soil texture same in both plots 1.85
Average	1	3.49

NOTE: The average of all three tests showed 3.49 times more silt in the bare tile than in the lines protected with fiber glass filter. It may appear at first sight that in test run No. 2 the fiber-glass filter caused a slight increase in siltation. But in test run No. 1, the filter was used in the coarser-textured soil, and the bare tile in the finer-textured soil. In this test there was 7.69 times more silt in the bare tile plot having the finer-textured soil. When the filter was changed to this finer soil for test No. 2, the relative silt accumulation was reduced to almost the level of that in the bare coarser-textured soil. Actually these were significant tests in favor of the filter.

Effect of Fiber-Glass Filter on Discharge

Records of discharge for tests Nos. 1, 2 and 3 were obtained for a total of 88 days. During this time 16,652 cu ft of water were discharged from the filter-protected plots and 9,818 cu ft from the bare tile plots. The average discharge from the plots with filters was thus 1.70 times greater than from the bare tile plots.

The discharge from the filter-protected plots averaged 18.7 in. of depth over the area of the tank of water in 24 hr. For the bare plots it was 11.0 in. A tile drainage system for this type of soil would normally be designed to remove about ½ in. of water from the area drained in 24 hr. Thus the filtered plots were removing water from the soil 37.5 times faster than required under field conditions. The bare tile plots were discharging water 22.1 times faster than normal field requirements.

The relatively high velocity of water through the joints in the plots with filters would probably carry with it a larger percent of silt than under field conditions. The ability of moving water to carry solid particles increases rapidly with an increase in velocity. Thus under field conditions the fiber glass should give greater protection against silting than under the accelerated conditions of the tests.

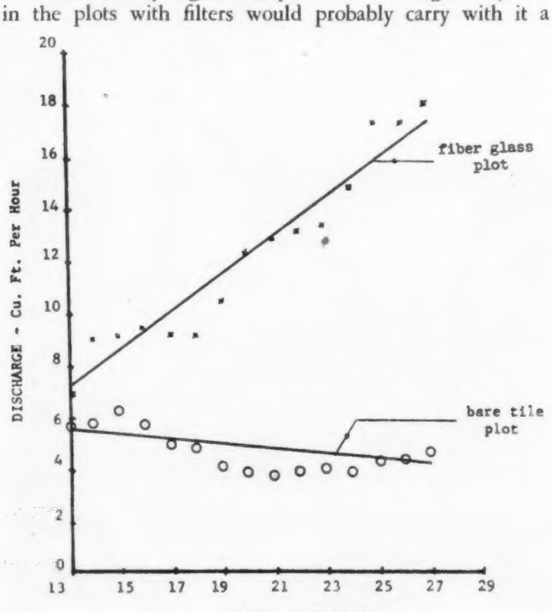


Fig. 1 This graph shows the discharge from drainage plots in a test run May 13 to 27, 1958, for tile with and without fiber glass filter

Fig. 1 shows the discharge from May 13 to 27, inclusive. Identical soil was used in each plot. The average discharge from the fiber glass plot for this period was 11.95 cu ft per hr. From the bare tile plot it was 4.67 cu ft per hr. The average discharge from the filter plot for this 15-day period was 2.56 times greater than from the bare tile plot. It should be noted that the rate of discharge from the filter plot was consistently increasing for this period. The rate from the bare tile plot was slightly decreasing. The discharge rate of both showed a tendency to level off during the last three days of the test.

TABLE 2. RELATIVE RATE OF SILT ACCUMULATION PER CUBIC FOOT OF WATER DISCHARGED

Basis: Ratio of silt to water in fiber glass filter plot as unity

Test run number	Tile lines with fiber-glass filter	Tile lines without fiber glass filter
1	Coarse-textured soil 1	Finer-textured soil 15.02
2	Finer-textured soil 1	Coarse-textured soil 0.93
3	Soil texture same in both plots 1	Soil texture same in both plots 5.11
Average	1	7.02

The average of all three tests in Table 2 showed seven times more silt per cubic foot of water discharged in the bare tile lines than in the lines having glass-fiber protection. (N.B. for explanation of apparent inconsistency in test No. 2, see note under Table 1.)

In test No. 4 the tile in one plot were completely wrapped with the filter material and compared with bare tile.

In the previous test with 88 days of record, the fiber-glass filter covered only 75 percent of the upper portion of the tile. It was desired to determine the extent of protection against silting and the effect on discharge with complete wrap-around application of the filtering material. Identical soil was used in both plots. As in the previous tests, water was applied to the plots as fast as the soil would take it. Test No. 4 ran for eight days continuously.

Effect on Rate of Discharge

Fiber glass plot, 360-degree wrap	15.75 cu ft per hour
Bare tile plot	6.94 cu ft perhour

Effect on Siltation

Fiber glass 360-degree wrap	Trace
Total silt (bare tile)	5985 grams

While the tests reported in this paper were not of sufficient duration to be conclusive, they do suggest the possibility of almost complete protection against silting with 360-deg wrap of the glass fiber in the soil tested. It is probable that about equal protection against silting could be secured by laying the tile on asphalt-impregnated glass fiber and 75-deg wrap of regular fiber glass for the upper part of the tile. The stronger asphalt impregnated fiber would help keep the tile in alignment in unstable soils.

Operation of Fiber Glass Filter

Any screen with a mesh fine enough to exclude all the fine sand and silt will quickly clog. This has long been recognized in the use of well screens. Well screens are successful because they do permit the fine material just outside the screen to pass through. Material too coarse to pass through the mesh then moves closer to the outer wall of the screen. It is the concentration of this coarser material near the screen that keeps the finer material out and permits the water to pass through more rapidly. In wells this process is often accelerated by a process known as "surging".

The mechanical analysis of the soil used in the tests shows a gradation from clay through silt to coarse sand. This is the condition necessary for the successful action of the well-screen type of protection.

With sufficient amounts of relatively coarse material such as are found in this soil, a protective sand filter should develop before an excessive amount of the fine material has entered the tile, after which only clear water will pass through the filter.

Without the fiber-glass filter, many joint spaces are too large to permit the development of the protective layer of coarse material. This is probably true even though all joints touch at some point in their circumference. What the soil scientist classifies as sand, actually has a small particle diameter.

Effective Particle Diameter of Sand

Very coarse sand	0.08 to 0.04 inch
Coarse sand	0.04 to 0.02 inch
Medium sand	0.02 to 0.01 inch
Fine sand	0.01 to 0.004 inch
Very fine sand	0.004 to 0.002 inch

Summary

Silting of tile drains is a serious problem in many fine, sandy soils. Covering the tile with organic material such as hay, straw or corn cobs has been only partially successful. The experiment reported in this paper was to determine the effectiveness of a thin filter or screen made of reinforced glass fibers placed around the tile.

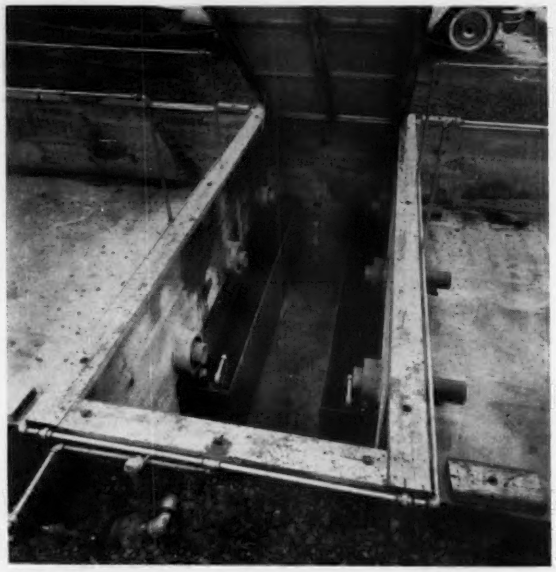


Fig. 2 Test plots consist of two monolithic reinforced concrete tanks, 11 by 11 ft and 32 in. deep. A pit between the tanks for metering equipment is 3 ft wide and 5 ft deep

The soil used in these tests was a disturbed soil. Since this is a sandy soil, disturbing it did not appreciably change the structure. Neither would the rate of free-water movement through it be seriously altered.

Rate of Silting. The average of three tests running for 88 days showed the silt accumulation in the bare tile to be 3.49 times greater than in the filter-protected tile.

Rate of Water Discharge. The rate of discharge from the fiber-glass-protected lines was 1.70 times greater than from the bare tile lines. (The average of the first three tests had 75 percent of the joint space protected.)

Silt Accumulation per Cubic Foot of Water Discharged. Each cubic foot of water entering the bare tile lines contained seven times more silt than a cubic foot of water from the fiber-protected lines (average of first three tests).

Fig. 3 *(left)* Each test tank has three 4-in. tile lines laid 5 in. above bottom of tank. Tile are laid to a grade of 0.1 ft per 100 ft with nine 12-in. lengths and one 24-in. length of tile in each line. • Fig. 4 *(right)* Tile lines are identical except that the tile in one tank are wrapped with fiber glass filters covering about 70 percent of the tile circumference

In Test No. 4 the filter was completely wrapped around the tile in one plot. The other plot had bare joints. In this test the filter gave almost complete protection against silting. The discharge from the filter-equipped plot was 2.26 times greater than from the bare-tile plot in this test.

APPENDIX

The glass-fiber mat used in these experiments was a porous, felt-like material composed of a jackstraw arrangement of individual filaments of glass fibers bonded into a uniform sheet with a thermo-setting resin. Physical and chemical properties of the glass mat were as follows:

Type of glass	– Lime-borosilicate
Diameter of glass filaments	– 0.00055 in.
Type of binder	– phenol formaldehyde
Percentage of binder	– 18
Weight of mat per 100 sq. ft.	– 1.05 lb
Nominal thickness	– 0.020 in.

The material is a product of Johns-Manville Fiber Glass Inc.

. . . Rotary Tiller

(Continued from page 603)

basic tine shapes included in ths particular study, considering the basic characteristics of rotor horsepower, traction horsepower, average horizontal and vertical forces, pulverization, dispersion of surface residues, chopping and winding of surface residue, and the sub-soil condition.

The operational conditions are indicated at the top of the chart. These particular conditions were chosen as being nearly ideal. In addition, typical tine shapes were used that are commercially available. The dotted lines show the range of rotor horsepower measured on several different makes of hoe and slicer tines.

From an over-all standpoint, it is easy to see why the trend has been toward the increased use of hoe-shaped tines. The one factor that is not as favorable for hoe tines as for the others is with regard to the condition of the tilled subsoil. The desired characteristics would be a loose, uneven subsoil, to insure a minimum sole effect for more thorough water penetration.

The pick-type tines, while excelling in this subsoil characteristic, are not as desirable from a power standpoint, and have poor chopping and winding characteristics so far as surface organic matter is concerned. In addition, particularly at the lower rotor speeds, the pick tines (only the rigid type tested) do not lend to a smooth operating machine due to the high vertical forces.

The slicer tines, while in general being as good as the hoe tines from a power-consumption standpoint, are not as desirable with regard to the degree of pulverization and their ability to chop surface organic matter, particularly when cultivating at shallow depths.

Possibilities for Further Improvement

The influence of rake angle on a basic hoe tine shape was investigated by building a series of hoe tines in which the approach, sweepback, and bend angles were held constant and the rake angles were varied from 10 to 30 deg. Fig. 13 shows the influence on net rotor horsepower and

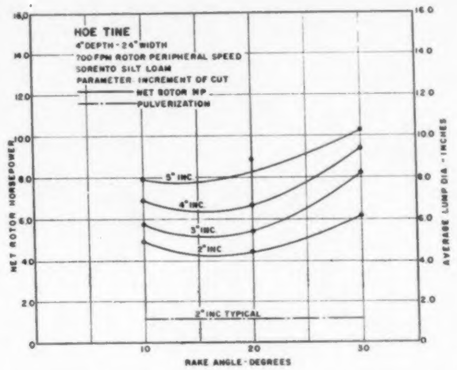


Fig. 13 These curves show results of research on the hoe tine to determine optimum rake angle. It is interesting to note the optimum angle varies little over a wide range of increment cut. Bottom dotted line shows changes in rake angle, within ranges tested, has little effect on pulverization

pulverization for an intermediate tine tip speed and over a wide range of increments of cut. It was not expected that the optimum rake angle would be nearly the same for all increments of cut. These data show that for all increments of cut, the optimum rake angle is around 15 deg for an 18-in. rotor diameter.

Future work on exploring the influence of the other shape or angle factors may reveal other opportunities for similar optimum performance to influence future design.

Summary

A hydraulically controlled and actuated research vehicle and rotary tiller was developed to determine quantitatively rotor and traction power, rotor forces, and tillage characteristics of basic hoe, slicer, and pick tines.

Hoe tines are over-all the best when operated at the lower tip speeds and intermediate increments of cut for best utilization of power, cutting and dispersing surface organic matter, and pulverizing the soil.

This method of determining quantitatively the basic performance characteristics of tines for rotary tillers has resulted in considerable data that will lay the groundwork for future development directed toward making the rotary tiller means of soil preparation still more acceptable for gardening and farming.

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Hydrograph Synthesis

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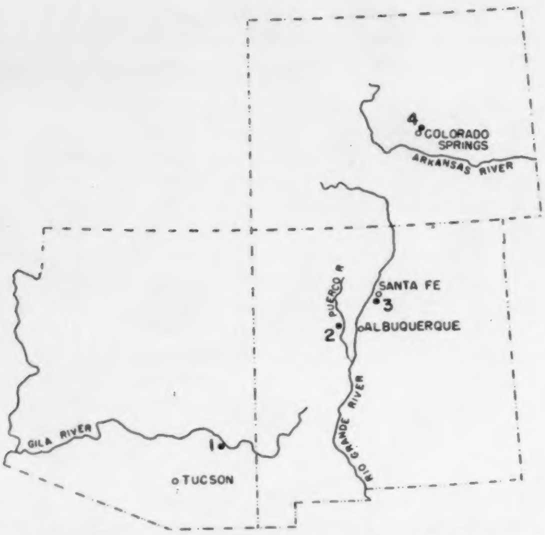

Fig. 1 Location map of experimental watersheds: (1) Safford, Ariz.; (2) Albuquerque, N. M.; (3) Santa Fe, N. M., and (4) Colorado Springs, Colo.

For many hydrologic design problems it is necessary not only to estimate the expected peak rate of runoff, but for flood-routing purposes to synthesize the entire inflow hydrograph. In areas where few runoff data are available, the designer must resort to some method of estimating hydrograph characteristics from physiographic features of the watershed. This is particularly true in the southwestern area of the United States where such data are extremely scarce. This paper presents a method of hydrograph synthesis developed especially for small arid land watersheds.

The method involves *(a)* estimation of a characteristic lag time from readily determined watershed parameters, *(b)* use of the watershed lag time to predict the hydrograph peak rate for an assumed total volume of runoff, *(c)* synthesizing the entire hydrograph using the lag time, the estimated peak rate, and a standard dimensionless hydrograph.

Development of the method is based on the analysis of rainfall and runoff records for 14 experimental watersheds in Arizona, New Mexico and Colorado (Fig. 1). The watersheds were established in 1938-39 by the Soil Conservation Service (USDA), and the studies have been continued since 1954 by the Agricultural Research Service in cooperation with the Soil Conservation Service and the agricultural experiment stations of Arizona, New Mexico, and Colorado.

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Santa Barbara, California, June, 1958, on a program arranged by the Soil and Water Division.

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Acknowledgment: The authors are grateful to J. H. Dorroh, Jr. hydrologist, EWPU, SCS, Portland, Ore., for numerous helpful suggestions used in the preparation of this paper.

The Experimental Watersheds

The 14 watersheds range in size from 11 to 790 acres. They are in four locational groups near Albuquerque and Sante Fe, N. M.; Safford, Ariz.; and Colorado Springs, Colo. All of the watersheds, except Colorado Springs W-I which has been cultivated for more than 50 years, are on arid or semiarid range lands at intermediate elevations (3500 to 7000 msl). Mean annual precipitation is about 8 in. for the Albuquerque and Safford watersheds, and 14 in. for Sante Fe and Colorado Springs watersheds. Over one-half of the precipitation and nearly all of the runoff results from intense convectional thunderstorms in the June to September period.

Runoff from each watershed is measured by a precalibrated triangular weir equipped with a water-level recorder giving continuous records of stage to 0.01 ft and time to 1 min. Each watershed has one or more 12-hr recording rain gages and standard gages, and each watershed or group of watersheds has a weekly recording gage. The periods of record are from 9 to 16 years. Detailed watershed characteristics are given in Table 1.

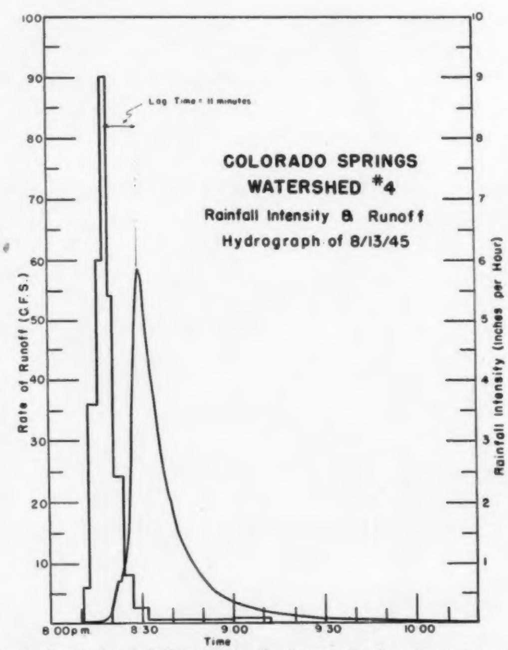

Fig. 2 Typical rainfall intensity (hydrograph plot shows lag time determinations)

for Small Arid-Land Watersheds

A method of estimating hydrograph characteristics from physiographic features of a watershed under study

TABLE 1. WATERSHED CHARACTERISTICS

Watershed	A Size, acres	S Avg. slope, percent	S_{sa} Avg. slope of source area, percent	DD Drainage density, ft per acre	T_L Lag time, min	W_{sa} Width of source area, ft	L_{sa} Length to source area, ft	Cover	Soils
				Safford, Arizona					
W-I	519	8.5	9.4	43	35	1690	9200	Shrubs-grass, 10-20%	Stony-sandy loam, moderate depth
W-II	682	12.4	19.7	70	19	1160	12300	Shrubs-grass, 10-35%	Stony-sandy loam, moderate depth
W-IV	764	2.6	2.6	106	46	1640	4800	Shrubs, 15-25%	Sandy loam, moderate depth
W-V	723	14.7	17.7	55	19	1500	12300	Grass, 10-35%	Stony-clay loam, moderate depth
				Albuquerque, New Mexico					
W-I	97.2	16.5	17.2	100	9	1420	720	Brush-grass, 10-25%	Sandy-clay loam, shallow rock outcrops
W-II	40.5	14.3	16.4	86	12	615	1790	Grass, 5-30%	Fine-sandy loam, shallow crusted
W-III	183.0	6.9	9.7	75	19	1210	1350	Grass-shrubs, 5-35%	Fine-sandy loam, shallow crusted
				Sante Fe, New Mexico					
W-I	50.0	9.9	10.4	89	16	680	2440	Grass-shrubs, 25-35%	Loam, shallow to moderate depth
W-II	790.0	4.3	5.4	42	41	1820	9180	Grass, 20-30%	Clay loam, moderate depth
W-III	51.6	18.9	19.4	143	7	880	620	Brush-grass, 10-35%	Sandy-clay loam, moderate depth
				Colorado Springs, Colorado					
W-I	10.6	4.2	4.7	Cultivated	6	290	810	Cultivated	Clay loam, deep
W-II	39.7	6.0	6.8	57	20	540	1720	Grass	Clay loam, deep
W-III	35.4	5.6	5.9	100	20	520	1810	Grass	Loam, deep
W-IV	35.6	8.4	9.1	180	12	720	1720	Grass	Sandy loam to gravelly-clay loam, moderate depth

Determination of Watershed Lag Time

The term "lag time" has been used in the literature to denote various time relationships between rainfall excess and runoff characteristics. It was found in this study that the least variable and most readily determined time parameter was the time from the center of mass of a limited block of intense rainfall to the resulting peak of the hydrograph. For the convectional thunderstorms causing flood runoff from the watersheds, there was little difficulty in selecting the intense rainfall block responsible for the runoff peak. The minimum duration of the block causing the peak varied, of course, with watershed size. Fig. 2 shows a typical rainfall intensity-hydrograph plotting from which lag time was measured. About 130 such plottings (consisting of several of the largest peak flows from each watershed) were made for determination of characteristic watershed lag time.

Correlation of Lag Time with Watershed Characteristics

Snyder (1)*, using data from the Appalachian Mountain area, has related basin lag time (which he defined as the time from center of mass of rainfall excess to peak of the unit hydrograph) to watershed length parameters. Linsley (2) modified Snyder's equation and applied it to watersheds on the western slope of the Sierra Nevada. The U.S. Bureau of Reclamation (3) has used channel slope in addition to length parameters in estimating lag time. None of these combinations of watershed characteristics correlated very well with lag time for the 14 watersheds in this study. Therefore, multiple correlations of lag time with various combinations of watershed and channel slopes and lengths, drainage density, shape, and size were made. Of some 50

*Numbers in parentheses refer to the appended references.

such multiple correlations, two were decidedly superior. These relationships are described in equations [1] and [2].

$$T_L = K_1 \left[\frac{A^{0.3}}{S_a \sqrt{DD}} \right]^{0.61} \quad . \quad . \quad . \quad . \quad . \quad [1]$$

Where:

T_L=lag time (time from limited block of intense rainfall to peak of hydrograph)

A=watershed area

S_a=average landslope of the watershed

DD=drainage density (total length of visible channels per unit area)

When length is in feet, area in acres, slope in percent, and lag time in minutes, $K_1=106$.

Equation [1] gave a standard error of estimate of 10.1 percent and a maximum deviation of 20.0 percent (Fig. 3).

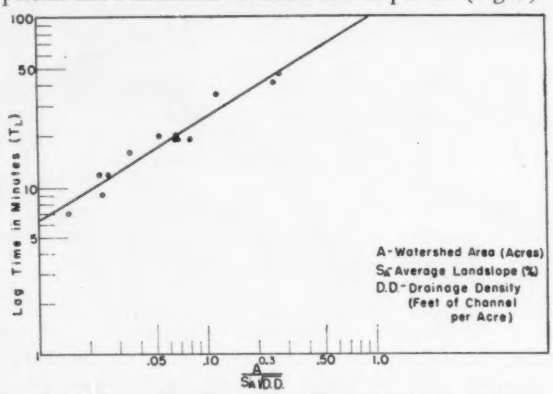

Fig. 3 Correlation of lag time with watershed parameters

In correlating lag time with watershed slope, it was noted that the slope of the half of the watershed having the largest average slope gave better correlation than did the slope of the entire watershed. This seemed to indicate that the steeper portion of the watershed may control the time of peak of the hydrograph even though rainfall excess occurs over the entire area. This gave rise to the concept of a controlling source-area for each watershed. The regression equation expressing lag time as a function of source-area parameters is:

$$T_L = K_2 \left[\frac{\sqrt{L_{sa} + W_{sa}}}{S_{sa} \sqrt{DD}} \right]^{0.65} \quad . \quad . \quad . \quad . \quad [2]$$

Where:

L_{sa}=length from outlet of the watershed to center of gravity of source area

W_{sa}=average width of source area

S_{sa}=average land slope of the source area

DD=drainage density for entire watershed

When length is in feet, slope in percent, and lag time in minutes, $K_2=23$. Equation [2] was derived by considering the half of the watershed with the highest average landslope as the source area. Limited use of the equation in estimating lag times for larger heterogeneous watersheds indicates that the source area may be any important fractional part of the total watershed area which has distinctly greater slope or drainage density than the rest of the area.

Estimates based on equation [2] gave a standard error of estimate of 8.4 percent, and a maximum deviation of 12.6 percent (Fig. 4).

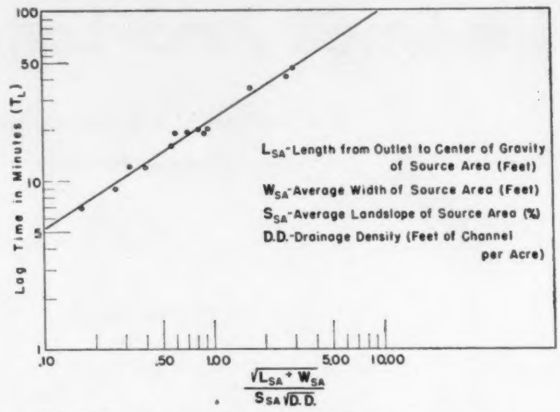

Fig. 4 Correlation of lag time with source area parameters

Equation [1] provides an estimate of lag time within practical confidence limits for reasonably homogeneous semiarid rangeland watersheds up to about 1,000 acres in area. Very likely the size limitation is dependent on the character of rainfall and should be considered to be the upper limit of area from which the maximum runoff is expected to occur from rainfall excess over the entire area.

The source-area concept, equation [2], gives a more refined estimate of lag time for watersheds which differ widely in physiographic characteristics in some major portion of the area from the rest of the watershed, or which are large enough so that maximum runoff may occur as a result of rainfall excess occurring over only a portion of the watershed.

Correlation of Peak Rate — Volume Ratio with Lag Time

Lag time was found in this study to be a major determinant of hydrograph shape, and it is logical to express the ratio of the peak rate of runoff (q_p) to the total runoff volume (V) as a function of lag time. Fig. 5 shows this corre-

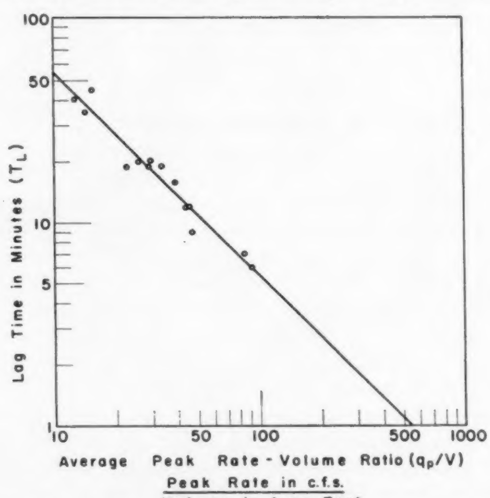

Fig. 5 Correlation of peak rate-volume ratio with lag time

lation of peak-volume ratio with lag time. The regression equation is:

$$q_p/V = K_3/T_L \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [3]$$

When q_p is in cfs, V in acre feet, and T_L in minutes, $K_3 = 545$.

Equation [3] gave a standard error of estimate of 14.6 percent with a maximum deviation of 29.0 percent.

Equation [3] is useful in estimating peak rate of runoff for any total volume of runoff. The relationship of peak-volume ratio to lag time also enables utilization of very limited hydrograph data for minor flows to predict peaks and estimate the hydrograph shape of much larger flows.

Development of Generalized Dimensionless Hydrograph and Mass Curve

For each of the 13 uncultivated watersheds included in the study, an average dimensionless distribution graph was prepared, using all suitable runoff hydrographs. The time base was made dimensionless in terms of the watershed lag time, and time increments of 20 percent of lag time were considered. The dimensionless distribution graphs for all watersheds were averaged, and a generalized dimensionless hydrograph and mass curve were computed (Fig. 6). The

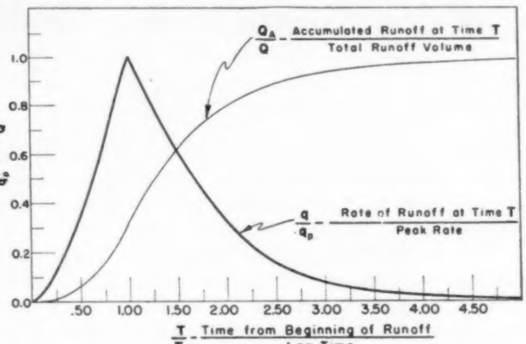

Fig. 6 Generalized dimensionless hydrograph and mass curve

synchronizing and averaging steps were more easily accomplished by working with distribution graphs rather than by working directly with hydrographs, since minor irregularities in the hydrographs were smoothed in preparing the distribution graphs. Coordinates defining the generalized dimensionless hydrograph and mass curve are given in Table 2.

TABLE 2. DATA FOR DIMENSIONLESS HYDROGRAPH AND MASS CURVE (Fig. 6)

T/T_L	q/q_p	Q_a/Q	T/T_L	q/q_p	Q_a/Q
0	0	0	1.6	0.545	0.671
0.1	0.025	0.002	1.7	0.482	0.707
0.2	0.087	0.007	1.8	0.424	0.742
0.3	0.160	0.020	1.9	0.372	0.773
0.4	0.243	0.036	2.0	0.323	0.799
0.5	0.346	0.063	2.2	0.241	0.841
0.6	0.451	0.096	2.4	0.179	0.875
0.7	0.576	0.136	2.6	0.136	0.900
0.8	0.738	0.180	2.8	0.102	0.917
0.9	0.887	0.253	3.0	0.078	0.932
1.0	1.000	0.325	3.4	0.049	0.953
1.1	0.924	0.400	3.8	0.030	0.965
1.2	0.839	0.464	4.2	0.020	0.973
1.3	0.756	0.523	4.6	0.012	0.979
1.4	0.678	0.578	5.0	0.008	0.983
1.5	0.604	0.627	7.0	0	0

Illustration of Method for Hydrograph Synthesis

The following example will illustrate the method of hydrograph synthesis. Walnut Gulch experimental watershed No. 4, located near Tombstone, Ariz., has been selected for the example because it is within the size range and climatic region represented by the watersheds from which the method was developed. The measured hydrograph having the largest peak flow for the four-year period of record was used for comparison with a computed hydrograph. Pertinent physical features for Walnut Gulch watershed No. 4 are:

Area *(A)*	– 590 acres
Average land slope *(S_a)*	– 9 percent
Drainage density *(D.D.)*	– 93 feet per acre

The average landslope was determined from a sample of slope measurements with an Abney hand level. Drainage density was determined by measuring the length of all drainage detail visible on an aerial photograph with a scale of 2 inches to the mile. Physiography of the watershed is relatively homogeneous; hence, equation [1] is used, which results in a value of 22.3 min for the lag time *(T_L)*. This compares closely with an average measured lag time of 24 min for five of the major runoff events for this watershed.

The next step is to compute, from equation [3], the peak rate of runoff *(q_p)* for any assumed total volume of runoff *(V)*. For a particular design application, V may be estimated from the assumed design storm rainfall volume and an estimated rainfall-runoff relationship, or a design storm runoff volume may be established directly. For this example, $V = 62.7$ acre-feet, the actual measured volume of runoff for the storm of July 19, 1955, was used for a realistic comparison of an actual and a computed hydrograph. Thus q_p is computed to be 1530 cfs. The measured peak was 1425 cfs. Fig. 6, is entered with values of T/T_L to obtain values of q/q_p, enabling the computed hydrograph to be determined in its entirety with any desired degree of detail. The computed and measured hydrographs are compared in Fig. 7.

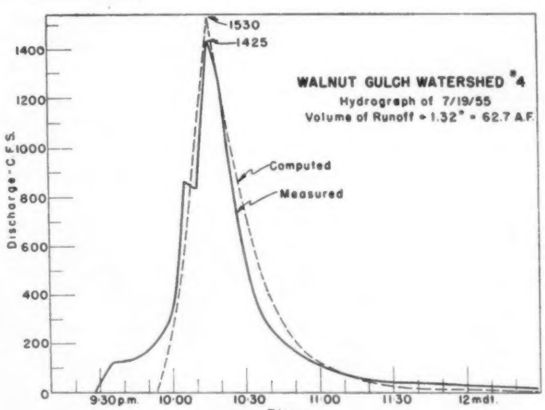

Fig. 7 Comparison of measured and computed hydrographs

Discussion and Conclusions

For the watersheds considered in this study, lag time as herein defined is the most significant time parameter in relating watershed influences to hydrograph shape. It was found that for a given watershed the rise time of the hydro-

(Continued on page 615)

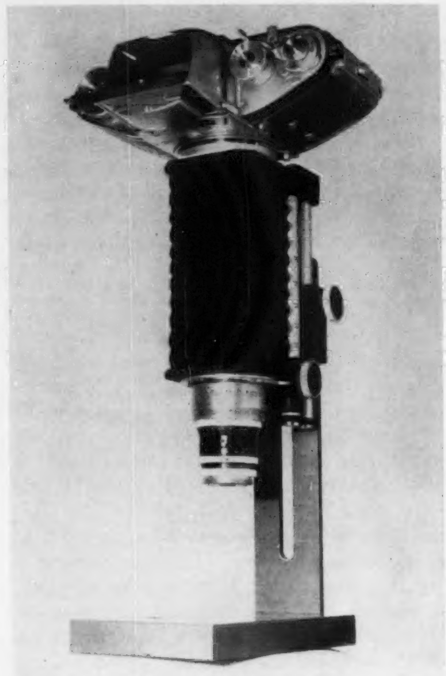

Fig. 1 A 35-mm camera with extension bellows. Note use of 16-mm movie lens in reverse position

Photography Solves Hay-Crushing Problem

Robert B. Barnick

Reaction of hay to crushing recorded graphically

DURING a preliminary research study of the development of a hay conditioner, numerous reports were examined, many of which dealing with hay crushing were found to be contradictory. The engineers were reasonably sure that crushing hay would result in faster drying, but they needed to know what really happened to the hay. That is, what happened to the structure and to the inside of the stem. These were questions that had to be answered prior to undertaking the design of a crushing unit that would be efficient, and yet result in gentle handling of the hay. They decided the best way to find out was to actually look at hay during the curing process.

The company's photographic department was called upon to undertake a study of legumes and grasses to see if they could record graphically the difference between crushed and uncrushed material. In order to get a better look, the photographic department decided to use photomacrography, that is, photography of low magnification (up to 50X) without the use of a microscope, in which the lens is extended beyond its normal length to obtain the magnification. The following simple formula is used to calculate the magnification:

$$M = v - f/f$$

in which v = lens to film distance
f = focal length of lens
M = magnification.

To give an elementary example of the application of the above formula, if v is 200 millimeters and f is 50 millimeters, then M will equal 3, or a magnification of three times. The lens may be extended through the use of bellows or extension tubes for the camera.

For our photomacrographic studies, a 35-mm camera was used with an extension bellows and through-the-lens focusing (Fig. 1). The lens used was a 16-mm movie camera lens which was reversed to take advantage of an optical law which results in a sharper image when the lens is reversed.

Vibration being a serious problem, since it too is magnified, we tried to make the camera, stand and sample to be photographed as integral as possible so as to reduce the effect of vibration.

Our studies ranged from three to eight times magnification. Fig. 2 shows samples of crushed and uncrushed alfalfa. It will be noted that, in addition to cracks in the outer layers of the stem, the pithlike material in the center of the stem is compacted so that it can no longer hold moisture. This frothy material in the center of the stem can be likened to shaving lather which, as is known, holds moisture quite well. The crack in the stem allows the moisture to escape from the interior of the plant.

We have found considerable variety in the characteristics of alfalfa depending on where it was grown, the time of year, and the amount of moisture received during the growing cycle. The large, heavy-stemmed alfalfa of the Southwest was found to crush very easily, while the second crop of midwestern alfalfa resists crushing. Our study led us to the conclusion that there is no stem of alfalfa that is "typical."

We found that crimping alfalfa also cracks the shell and breaks up the center structure of the stem, but only at

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Paper prepared expressly for AGRICULTURAL ENGINEERING.
The author — ROBERT B. BARNICK — is supervisor of photography, Farm Equipment Research and Engineering Center, International Harvester Co.

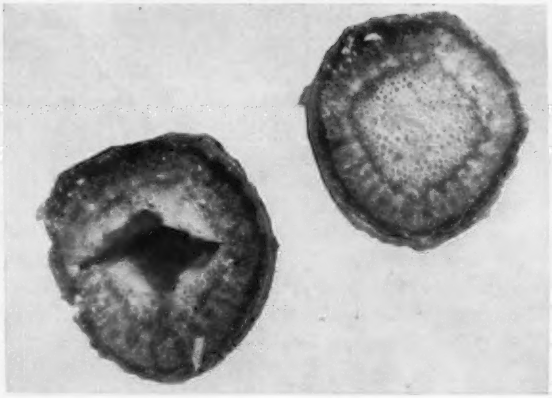
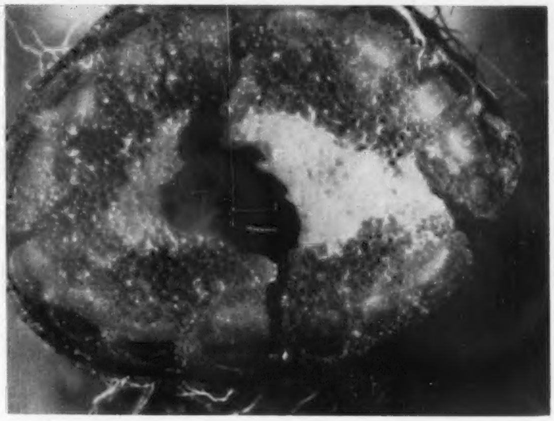


Fig. 2 *(Left)* Crushed alfalfa at left and uncrushed alfalfa at right

Fig. 3 *(Below)* Magnification of crushed clover



intervals. Clover and timothy behaved much like alfalfa during drying. Clover was found to be exceedingly juicy and to respond well to crushing (Fig. 3). Timothy has an insulating wrapper. This wrapper, however, tends to "unwrap" as the stem dries.

With the graphic evidence of the reaction of hay to crushing, the engineers continued the design of the new crusher. Several designs of machines using different methods of crushing were tested and discarded. As a result of this development work, rubber rolls made from tire carcass disks were built and tested. After hundreds of hours of testing on a test stand (Fig. 4), these rolls were incorporated in a field unit.

The rubber rolls have several advantages which make them ideally suited for a hay conditioner. They run quietly, they are self-cleaning to some extent, they resist damage from obstacles such as rocks, and they readily crush the hay the entire length.

During the development of the crusher with tire-carcass rolls, additional photographic studies were made to support the evidence of the drying tests. A time-lapse movie setup was constructed using inexpensive materials and existing camera equipment. Fig. 5 shows this "homemade" time-lapse setup. The camera was focused on a piece of slide glass to register the image. The samples were then pressed against the glass. In the case of cutaways (cross sections) the sample was held in perfect contact with the glass so no moisture could escape.

The foregoing indicates how photography proved to be a useful tool in helping design, develop and market a hay conditioner. In addition to the record and promotional uses, the following other aspects of photography were employed:

1 Time lapse was used to study actual drying.

2 High-speed motion pictures (4,000 pictures per second) were used to study the action of the material as it passed through the rolls. (Some of these were later used in a promotional film.) Photos were used to assist in making the patent drawings. (These drawings were particularly difficult due to some compound curves which had to be clearly illustrated.)

3 Color slides and movies were used to report the progress of the machine to management personnel, and photographs were used to illustrate clearly problems to vendors.

4 The engineering reports were illustrated with photographs.

5 Still photographs were used in promotional literature.

Photography plays an important roll as a tool of engineering. Our engineers have come to lean heavily on photography to show them things they literally cannot see with their own eyes. It is true today, and will be even more so in the future, that photography is an indispensable engineering tool.

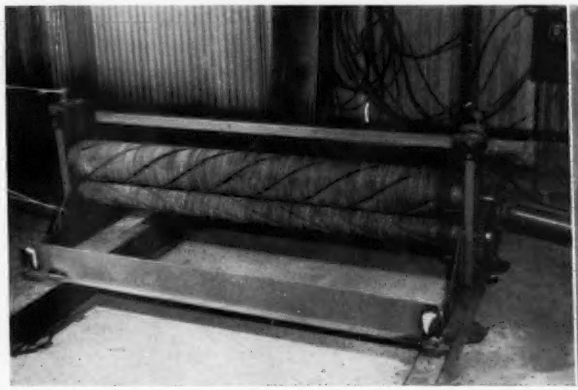


Fig. 4 Crusher-roll test stand

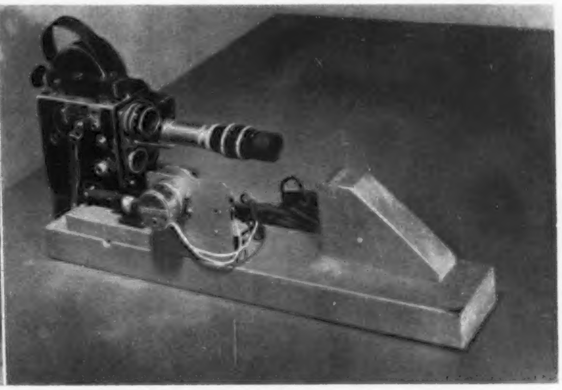


Fig. 5 Time-lapse movie setup

INSTRUMENT NEWS

Low-Cost Two-Channel Switch for Recording Potentiometer

F. H. Buelow
Member ASAE

SEVERAL methods have been proposed and used for increasing the latitude of recording potentiometers (1, 2, 4)* The switch described here differs from the other methods in that it only doubles the capacity, while the others increase capacity by four to fifteen times. This switch includes a time clock for starting the recording cycle automatically, and is lower in cost than most of the other methods. The complete switch costs less than $100 for parts at current prices. Although alterations are made on the potentiometer to use the automatic switch, the potentiometer can still be used in the normal way without the switch.

The primary change to the potentiometer is the addition of a SPDT microswitch (S_M) as described by Hinkle (3). The microswitch is in the position shown in Fig. 1 during the recording of points 1 and 2, and in the opposite position for points 3 through 16 (for a 16-point recorder).

Four wires connect the potentiometer to the automatic switch as shown in Fig. 1. The wiring inside the potentiometer consists simply of connecting the microswitch as shown and adding the wires to the plug connecting the potentiometer and switch.

The automatic switch is constructed as a separate unit as shown in Fig. 2. The time clock and all controls are located on the front panel. Thermocouples are attached to terminal strips on the rear panel. The 32 thermocouples (with a 16-point recording potentiometer) are connected to the potentiometer through two 32-point, single-throw, gold-plated contact relays (R_A and R_B). The relays are connected to the potentiometer with thermocouple wire through a 32-prong plug not shown in Fig. 1; thus it is possible to separate the potentiometer and switch simply by unplugging the power plug and the thermocouple plug.

The thermocouple relays are controlled with a DPDT impulse operated relay, (R_2) which also controls the two indicating lights on the front panel to show which relay is closed. When the potentiometer printer power is off, both lights are off and both thermocouple relays are open.

A switch (S_3) is used to control the time clock motor. A DPDT pushbutton switch (S_4) can be used to change the set of thermocouples (or channels) connected to the potentiometer. Normally, however, the channels will change automatically during the recording cycle. One channel can be locked in by opening switch S_5 (S_5 is marked "automatic switch" on the front panel). This switch will also inactivate the push-button switch, S_4.

For normal operation, the time clock is set to close its switch until between 19 and 31 of the points have been recorded (on a 16-point recorder). Switches S_1, S_3, and S_5 are closed. The time clock starts the printer and keeps it going through the first channel and part of the second. After the timer switch is opened, the microswitch keeps the recorder running until the end of the cycle.

If it is desired to record only one channel intermittently, switch S_5 is opened, and the time clock is set to close its switch until 3 to 15 points have been recorded.

In order to record two channels continuously, switches

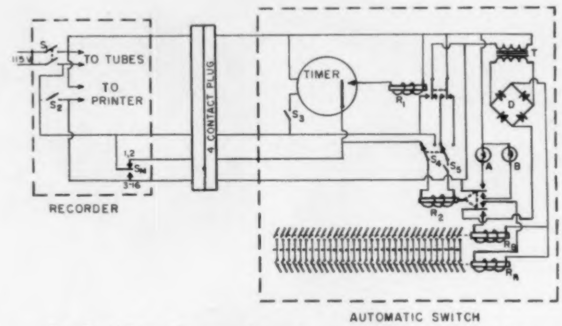


Fig. 1 Wiring diagram for automatic switch and recording potentiometer

S_1—Main power switch in recorder
S_2—Chart drive switch in recorder
S_3—SPST timer switch
S_4—DPDT push button channel change switch
S_5—SPST channel lock switch (marked "automatic switch" on front panel)
S_M—SPDT microswitch in recorder
A, B—Channel indicator lights
D—Bridge rectifier
T—Transformer, 12-volt output
R_1—DPDT relay
R_2—DPDT impulse operated relay
R_A, R_B—32-point, gold-contact, single-contact relays

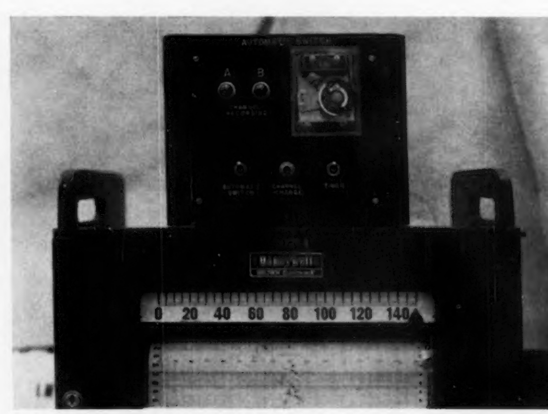


Fig. 2 The automatic switch on a potentiometer recorder

An Instrument News Contribution. Articles on agricultural application of instruments and controls and related problems are invited by the ASAE Committee on Instrumentation and Controls, and should be submitted direct to Karl H. Norris, instrument news editor, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md. Approved for publication as Journal Article No. 2382 of the Michigan Agricultural Experiment Station. The unit shown was designed and constructed for environmental studies in greenhouses by the horticulture department, Michigan State University.

The author — F. H. BUELOW — is assistant professor of agricultural engineering, Michigan State University, East Lansing.

*Numbers in parentheses refer to appended references.

S_1 and S_5 are closed, switches S_2 and S_3 are open. The timer is turned so that its switch is closed.

When manual starting to record a certain channel is desired, switches S_1 and S_5 are closed. The timer is turned so its switch is open. The recorder is started with switch S_2 (the chart drive switch in the potentiometer). The channel may be selected with push-button switch S_4. The channel may be locked in by opening switch S_5. This procedure may also be used to record a channel between automatic recording times without turning off the time clock with switch S_3.

The circuit is designed so that no power is consumed by the automatic switch during the idle portion of the recording cycle except by the timer motor.

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2 Haynes, B. C. Jr. Increasing the latitude of a recording potentiometer, AGRICULTURAL ENGINEERING 34, 712, 1953.

3 Hinkle, C. N. Device to record hourly temperatures, AGRICULTURAL ENGINEERING 34, 636, 1953.

4 Taylor, J. G. Multipoint recording, Instruments 25, 1080, 1952.

. . . Hydrograph Synthesis

(Continued from page 611)

graph (time from beginning of runoff to the peak) varied between much wider limits than did the lag time. Rise time is frequently affected by the duration of rainfall excess and minor variations in rainfall intensity—whereas lag time is relatively independent of the rainfall pattern. Rise time varied from 74 percent to 145 percent of lag time for the individual watersheds in this study. The average for all watersheds was 102 percent. Accordingly the generalized dimensionless hydrograph was constructed with lag time and rise time equal. However, it may not be concluded from this coincidence that the time of rise of the hydrograph affords a generally satisfactory index of watershed influence on the hydrograph shape. The measured hydrograph of Fig. 7 illustrates this point. The first portion of the rising limb of the hydrograph, from 9:38 p.m. to about 9:55 p.m., was caused by a minor burst of intense rainfall. That this portion is relatively insignificant in characterizing the overall hydrograph shape is indicated by the fact that only 8 percent of the total volume of runoff occurred during this 17-min period. The rise time of this hydrograph is 47 min compared with a measured lag time of 20 min. It is the latter time factor which is important in describing hydrograph shape and its relation to watershed physiography.

It should also be pointed out that lag time as defined in this paper does not correspond, except for very small watersheds with extremely simple drainage patterns, to the classical concept of "time of concentration." For natural watersheds of any size and complexity of drainage, runoff water originating from the most remote portion may and usually does arrive at the outlet too late to contribute to the flood peak. Accordingly, lag time will generally be less than the time of concentration for a given watershed.

For determination of lag time in the watersheds considered in this study, it is evident from equations [1] and [2] that the most important physiographic feature is land slope. All of the correlations involving channel slope were distinctly poorer than those involving land slope. Where flood peaks are almost exclusively the result of cloudburst-type convectional thunderstorms, it is highly probable that runoff water moves off the watershed and into the main channel in the form of abrupt translatory waves. Momentum effects might be expected to predominate over channel resistance effects in this type of flow. Consequently, from theoretical considerations, one would expect land slope to be of more importance than channel parameters in determining lag time, as was found in this case.

In equation [1] watershed area (A) provides an index of distance travelled, while in equation [2] the width of source area (W_{sa}) and the length of source area (L_{sa}) constitute a direct measure of travel distance. In both equations, the drainage density term (DD) provides a measure of what might be termed the hydraulic efficiency of the watershed i.e., the relative proportion of channel versus overland flow.

Within the range of conditions encountered in the present study, the shapes of the dimensionless hydrograph and mass curve (Fig. 6), were found to be independent of rainfall pattern and of soil and cover condition.

Experience has shown that estimates of runoff volume-frequency relations made from short-period records may be transferred to somewhat dissimilar watersheds with much greater confidence than is possible with similar estimates of peak runoff rates. Conversion of such a volume estimate to a corresponding estimate of peak rate on the basis of a lag time and correlated estimate of peak rate-volume ratio for the specific watershed being considered results in a substantially better estimate of the runoff peak.

The method of hydrograph synthesis presented is directly applicable to uncultivated arid-land watersheds of such size that major floods result from single thunderstorms producing runoff from the entire watershed. The authors feel that in order to satisfy this restriction the limit on size should be about 1000 acres for most areas of the Southwest. Work is currently under way to test the validity of this approach for watersheds of much greater area.

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3 U.S. Bureau of Reclamation—Unit graph procedures.

CORRECTION

The author of the article "Measuring Forces in Two or More Members with One Instrument" which appeared in the August issue of AGRICULTURAL ENGINEERING wishes to acknowledge that the technique was developed while doing research for the M.S. thesis at Purdue University under the guidance of Dr. J. B. Liljedahl and other staff members of the University.

. . . Research Challenge

(Continued from page 599)

to cut production costs, improve farming efficiency, and find new markets. Let us consider some of these problems and the possibilities for solving them through basic research in the agricultural engineering sciences.

Soils, Weeds, and Machinery

We all know that the primary purpose of the farm tractor is to reduce the farm labor required to grow crops—and that it is highly successful in this respect. But tractors have brought other problems that may be even more serious than labor from the standpoint of increased production in the years ahead. One of these problems is soil compaction. High-lug tractor tires are undoubtedly one of the most efficient soil packers in the world. Compacted soils interfere with root development and penetration, reduce infiltration and storage of soil moisture, and encourage wind and water erosion. It is estimated that in California alone a million acres have gone out of production because of soil compaction, principally by heavy machinery and irrigation. The problem is serious all over the country.

Before we can develop improved tractors and other machinery used on the land, we must learn several fundamental facts. First, we must learn more about the relationship of soil conditions to plant growth. We need to define our seedbed and rootbed conditions in terms of measurable properties of the soil system itself and not in terms of the machines that create these properties. Then we must learn the effects on soils of all kinds of tires and tracks and the stresses they impose on the soil. And we must know the distribution of forces applied to various soils by tools of different shapes and materials.

We found in land-forming studies in Louisiana, for example, that the land leveler, with its sharp-edged blade, compacts soil more than a big earth-carrying machine. Why is this? Is it a matter of point pressure and particle displacement? Is it different on heavy clay soil than on silty or sandy soils? What part does moisture, or the lack of moisture, play? These questions are involved not only in the use of land-leveling equipment but also in the use of such implements as the disk harrow, the disk plow, and the narrow-shank cultivator. They call for fundamental research in the physics and mechanics of soil particles. When we get the answers we need, we may even find that the limit to the pressure many soils will take—and still maintain their productivity—is a lot lower than we now assume. If this proves to be the case, we will need to give much greater attention to the development of minimum tillage or other practices that we haven't thought of yet.

In general, we have assumed that the soil must be plowed, and we concentrated on improving the plow. But we are learning that we don't need to plow—at least not as much as we do now. One of the big reasons for plowing, as you know, is to control weeds. But we are far enough along in research to know the good potentials of chemical methods of controlling weeds. And we may find still other ways that are even more effective and more economical.

Many of you have had the experience of seeing land that had not been plowed for several years suddenly show a full cover of weeds when it was plowed, even though none of the weeds had grown on that land for a long time. You have probably wondered how weed seeds could stay dormant in the soil for so long—sometimes for 20 years or longer—and then, following the plowing, suddenly germinate.

We now know—from basic research in plant physiology — that exposure to light in the plowing process, even though only for a few seconds, is responsible for triggering the germination. If we could find a way of making all the weed seeds in the soil germinate at once, in the dark, and then quickly kill the weeds by physical, chemical, or other means, we would be a big step ahead in our efforts to use our soils without damaging them. We can't do it now, but the possibility is there. And to realize it will involve research in the engineering sciences as well as in the biological and physical sciences.

Water Conservation

Considering the nation as a whole, water—or the lack of it—may set the limit on crop production in the not-too-distant future. Although we have been doing irrigation research in this country for more than 50 years, we still don't know how to irrigate without losing a large share of the available water. We used to flood the field because we wanted to get the water on in a hurry. In more recent years, we have tried to simulate rainfall by using overhead sprinklers, but we lose a lot of water through evaporation, both before and after the water hits the row.

If we could find a way to fog the water out—under the plant, close to the ground—so that the humidity in the immediate environment of the plant would slow down the transpiration rate, we would not only cut the loss from evaporation but could also use less water and still provide adequate moisture for good plant growth. A fogging system, especially if it were a continuous system, would be quite expensive today. And, of course, it might create some plant-disease problems. But the point is that we must consider all possibilities of making the most of our water supply. It is important now, and it will become an absolute necessity in the future.

Application of Pesticides

Some people call this the age of chemicals in agriculture. We use chemicals in producing farm products, in processing and storing them, and in various phases of marketing. Let us think for a moment about the chemicals being developed to combat insects, diseases, and weeds. In light of the terrific losses to these pests, why are farmers not using more of the many pesticides now on the market? Among the main reasons are the cost of materials and application and the problem of residues.

Today we use large amounts of active materials and larger amounts of water and other carriers, and we apply them without knowing precisely where they will land or how long they will adhere to the surface they hit. If we could learn more about spray droplets and dust particles, and how to regulate their size, we might find ways to get better coverage and more effective control, with only a fraction of the pesticide necessary at present. In this way, we might be able to reduce both costs and residues.

Here again the research problem involves particle mechanics. When we learn how to analyze and measure the physical forces and relationships that govern the movement of small particles, we should be able to control the deposition of all kinds and forms of pesticides. We may also find that entirely new principles of application are involved—requiring equipment designs quite different from those generally considered adequate today. It will be largely your job, working with scientists in other fields, to do the basic research necessary to bring these developments about.

Controlled Environment and Automation

In the past, we have assumed that our livestock must be adapted to the prevailing environment. Today our point of view is changing. Engineering research is showing that we can also adapt the environment to the animal. This will certainly give us more leeway in developing more productive and practical livestock enterprises for the future. For example, in moderate climates we may want to adapt animals to the environment. But in areas where climatic conditions range from one extreme to the other, it may prove more feasible to supplement genetic adaptation with controlled environment.

A few farmers, as you know, are already going in for partial environmental control, especially for pigs and chickens. The movement now getting under way to assemble large dairy herds into "cowpools" may be a trend that will be followed by beef cattle and sheep producers. We may find that environmental control will be essential for best results in these operations.

I am convinced, however, that before livestock production under controlled environment can be adopted on a broad scale—and with fair assurance of success—we must know a lot more about the situation than we do now. We have made only a start, for example, in learning what the environmental requirements are for sustained high output, good reproduction, and efficient use of feed. We must know the upper and lower limits of temperature and humidity, the proper rate of air movement and ventilation, and the space required for the well-being of each animal.

Furthermore, the internal environment of the animal must be considered, as well as the external. Disease, parasites, rumen organisms, and inherited susceptibility to disease are all part of the internal environment. What are the interrelationships between these things and external conditions—heat, cold, wind, or humidity? We don't know, for example, exactly how respiratory diseases are affected by changeable weather. How can animals crowded together over extended periods be protected from one another in order to prevent disease? Mainly because of this problem, hog producers are not yet sold on pig hatcheries.

Controlled environment in livestock production will certainly call for wider use of automation. And here again we need more fundamental information. We need to go beyond the principles already being applied by industry and develop new approaches to automatic handling and care of animals on farms.

We have made good progress, for example, in developing automatic equipment for mixing and delivering feed concentrates. But we haven't yet learned how to handle roughages automatically. Tomorrow's farmers won't be satisfied with hay in the mass or in the bale. There are indications that we may be able to put it in the form of large pellets or wafers. This one development could revolutionize hay harvesting, handling, and feeding operations. Storage space required would be only a fifth or sixth of that required for long or chopped hay and half to a third of that needed for baled hay. Transportation costs would be less, and hay wafers would undoubtedly be more adaptable to automatic handling.

Much of the work in livestock production involves handling individual animals—for example, in administering drugs. I believe that we should begin thinking about the possibility of managing our farm animals in ways that will permit us, in many more instances, to take care of them as groups.

New Sources of Energy

I have mentioned only a few of the problems agricultural engineers must help to solve if we are to meet the needs of the future. I could just as easily have selected others. I could have spent the entire time, for example, on the single topic—energy. Some people believe that the free world's supply of coal and oil will be exhausted within the next century—that atomic energy is our hope for the future. They may be right. I believe, however, that there are also immense possibilities, particularly for agriculture, in the field of solar energy. I am convinced that we can find practical and economic ways to use more of the power of the sun in producing and processing agricultural commodities.

I believe also that we can make more use of the energy of rain water. Think, for example, of the energy that is lost every time it rains. In studies at a North Central erosion station, we found that the energy in the average annual rainfall was about 45 million foot-pounds per acre, or nearly twice the energy used in plowing. In minimum tillage, we are learning that rain can supply some of the energy for smoothing the soil that we now get from the disk harrow. An additional dividend is better absorption of water by the soil and reduced erosion. We must analyze all our production practices to see if we cannot use this free energy to our advantage.

There is still another and different aspect of energy use in agriculture that deserves more research attention. This is the use of the various frequency bands of electromagnetic energy, all across the spectrum from low-frequency electric waves to cosmic rays. We are beginning to see potentials of some of these radiations for such diverse applications as controlling insects in stored grain, attracting insects into traps set up in the field, and treating seeds to improve germination. There surely must be many other applications of electro-magnetic energy that could prove beneficial to agriculture.

In closing, I want to emphasize a point which, I am sure, has been implied in many of the other discussions at this meeting. My point is this: Today's agricultural engineer no longer fits the definition, given in 1904 by a group of educators, as one who lays out farms, designs and constructs farm buildings and works, and makes and uses farm implements. A better definition today would describe the agricultural engineer as one who establishes new fundamental principles and basic requirements, and from these determines the techniques and specifications for particular applications of engineering to agriculture.

The complexities of modern research require each of you to be a highly trained specialist in your own field, with a workable understanding of all the other sciences and technologies fundamental to agriculture. You must apply your knowledge not only at the point of primary production, but also at the points involved in supplying goods and services to the farm, maintaining comfortable and healthful living and working conditions for rural populations, and facilitating the processing, storing, and marketing of farm commodities.

In accepting this research challenge, you have cut out quite a job for yourselves and for those who come after you. I am convinced, however, that, given the support and cooperation needed, you will fulfill your responsibilities, to the honor of your profession and the benefit of all our people.

Committee Report—Evaluation of Farm Structures Programs

For several years the Farm Structures Division has had a committee at work evaluating the presentations at Structures meeting sessions. The purpose of this evaluation is to upgrade program quality. Recent comments from the committee members indicate that this objective is being accomplished; the presentations are constantly improving. The following suggestions, to upgrade program quality, have been made by the committee:

For the benefit of future speakers the most common criticism encountered is that visual aids are inadequate. Aids with too small lettering and too much on a single slide are often used. The publications of the Ethyl Corp., "Slides: Confusing or Clear" and "Make Slides Worthwhile" are good references to follow for top-quality slides.

At almost every meeting mechanical difficulties with projection equipment have caused distractions. The person presiding should always be sure the equipment is operable and that spare bulbs are available.

In summary, the committee has found that the small things of the program make the real difference. When some small thing goes wrong, it ceases to be small.

TECHNICAL PAPER ABSTRACTS

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. ASAE members may obtain copies of these papers without charge by returning order forms supplied upon payment of membership dues. Non-members, and members requesting more than 10 copies, may purchase papers at 50 cents each to cover carrying charges from the American Society of Agricultural Engineers, St. Joseph, Mich.

Electronic Flowmeters for Measuring Liquid Flow in Milk Pipelines, by R. H. Brown, associate professor of agr. eng., University of Georgia, Athens. Paper presented at the Annual Meeting of ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program arranged by the Electric Power and Processing Division. Paper No. **59-306.**

This paper presents the metering problem of measuring milk-flow in a complete pipeline milking system. The author points out that it is believed that quantity-type flowmeters would be best adapted to this application, and that since no electrical or electronic type flowmeters are available for this metering need, efforts were made to design and test such a meter. He also states that ideas were worked out for three basically different meters which utilized electrical or electronic transducers and which would measure weight rather than rate of flow, and he explains that pilot models of three meters were designed, constructed, and tested, both in the laboratory and in the milking barn, with the following operating principles: Batch-type weigher, batch-type volumeter; batch-type volumeter, compensated; and continuous weigher. Although the meters performed satisfactorily in the field and their principles appeared to be sound, more development and refinement is required before they would be acceptable for general use in a testing program, according to the author.

Drying Rate and Field Loss Comparisons of Hay Harvesting Methods, by Morton M. Boyd, instructor, agr. eng., University of Massachusetts, Amherst. Paper presented at the Annual Meeting of ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-129.**

This paper deals with two effects of hay harvesting methods: The effect of method of field curing rate, and the resultant field losses for the various methods. Particular emphasis is placed on the use of the flail-type forage harvester for hay harvest and conditioning. Also discussed are additional tests that were made using a smooth-roll hay crusher. The author states that under good drying conditions the flail-cut crop dried most rapidly, with the crushed, crimped, and conventionally cut material following in that order, and that an additional advantage of the flail harvester which appeared in the machine is capable of mowing and conditioning equivalent areas, compared to other methods, in considerably less time. Also mentioned is the fact that field losses were divided into two parts: Pick-up losses due to mechanical effects of conditioning, and stubble losses accounting for the difference in height of stubble remaining after conditioning. Though the flail harvester produced rapid drying rates further research is indicated concerning possible methods for reducing field losses, according to the author.

An Evaluation of Truss Design and Sidewall Anchorage, by Harold T. Barr, head, agr. eng. dept., Louisiana State University, Baton Rouge. Paper presented at the Annual Meeting of ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program aranged by the Farm Structures Division. Paper No. **59-414.**

An analysis of a survey made in South Louisiana, after the hurricane of 1957, is given in this paper. The most significant errors of construction in farm buildings found during the survey, according to the author, were: Rafters spaced 3 to 4 ft with only toenails holding rafters to plate or pole; purlins and girts too far apart and toenailed with 16d nails; a lack of bracing in all parts of the structure; no metal connectors were found on any of the buildings, which, it is believed, in some form or type would aid the building in withstanding storms at a relatively low cost; poles not set deep enough or back filled correctly (no correlation was found between depth of setting or condition after the storm); corrugated galvanized roofing nailed with two few, too short, and, many times, small headed nails with no lead or composition washers; and aluminum roofing applied with small head steel nails.

Curing Rates, Field Losses, and Feeding Response with Crimped, Rolled, and Untreated Alfalfa Hay, by R. A. Kepner, J. R. Goss, J. H. Meyer, and L. G. Jones, respectively, professor of agricultural engineering, assistant agricultural engineer, associate professor of animal husbandry, and specialist in agronomy, University of California, Davis. Paper presented at the Annual Meeting of ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-132.**

This paper discusses the tests and studies made at the University of California, Davis, with two models of smooth-roll crushers and two crimpers, which included determination of drying rates, field losses, and chemical analyses for all six cuttings of a four-year-old alfalfa field. Feeding trials with sheep were conducted, using hay from three of the cuttings. The authors state that these studies showed that curing times with either crimpers or smooth-roll crushers were usually two days less for conditioned than for unconditioned hay; that field losses due to mowing and conditioning exceeded those due to mowing without conditioning; that crimped hay was lower in protein and higher in fiber than the rolled or unconditioned hay; and that in feeding trials with sheep, the average gain per 100 lb of feed consumed was 15 to 20 percent greater with rolled hay than with crimped or unconditioned hay. The authors also explain that field experience during these tests was too limited to yield much general information regarding operational problems with the conditioners.

Frost Protection by Wind Machines and Heaters, by F. A. Brooks, A. S. Leonard, T. V. Crawford, and H. B. Schultz, respectively, agricultural engineer, specialist-lecturer, assistant agricultural engineer, and associate specialist, Agricultural Experiment Station, University of California, Davis. Paper presented at the Annual Meeting of ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-114.**

According to the authors of this paper, the use of blowers for winter frost protection has been almost universal for citrus in California but not for spring frosts in deciduous orchards when the nocturnal temperature inversion is naturally weaker. This has led to the development of blowers equipped with burners to heat the jet. Field tests of blowers with heated jet both above tree tops and under the twig canopy show that the added heat decreases the area of moderate protection while increasing the temperatures very close in. Physical analysis of upturn in trajectory of a stationary, inclined jet in a temperature inversion reveals a natural level of vertical oscillation due to buoyancy and momentum, considerably below the propeller level in tower machines. This level would be raised if heat were added to the jet while the same heat if liberated throughout the orchard, as found desirable in practice, would lower the neutral level of jet trajectory. Determinations of downward eddy transfer of heat in stable air are not satisfactory but may be measurable in the near future by eddy correlation techniques developed in Australia.

A force balance interpretation has been developed of the jet action against the inflow tendency of surrounding colder air which shows how the machine operates to better advantage after modifying the temperature gradient of the nearby air. This probably explains the failure of a blower reported in Florida to regain its effectiveness after a shutdown of 35 minutes. This same logic also explains the advantage of multiple installation of machines except for the question of increased heat transfer downwards from overhead air by the forced increase in turbulence. This is such a complex problem that a fluid dynamics model tank has been constructed to permit controlled experiments of various possible machine arrangements.

Evaluation of Flame Burner Design for Weed Control in Cotton, by L. M. Carter, R. F. Colwick, and J. R. Tavernetti, respectively, agricultural engineer, Cotton Harvesting Section, AERD, ARS, USDA, Shafter, Calif.; head, Cotton Harvesting Section, AERD, ARS, USDA, State College, Miss.; and agricultural engineer, University of California, Davis. Paper presented at the Annual Meeting of the ASAE at Cornell University, Ithaca, N. Y., June 1959, on a program arranged by the Power and Machinery Division. Paper No. **59-139.**

Flame cultivation is rated as an effective tool for mid- and late-season control of weeds in the growing crop after cotton has reached a height of at least 4 in. It is reported that a better understanding of the capabilities and limitations of the flame cultivator for weed control in cotton has been gained recently through correlated laboratory and field testing. These results, as mentioned in the article, are: that the effect of bed profile irregularities and design and setting of flame burners have been found to be the principal factors in plant damage; that no differences in the Arkansas and Stoneville burners were found; that a single burner setting has shown good results for both burners; and that flame cultivation will control any seedling weed provided the application is made before the weed develops an extensive root and foliage system.

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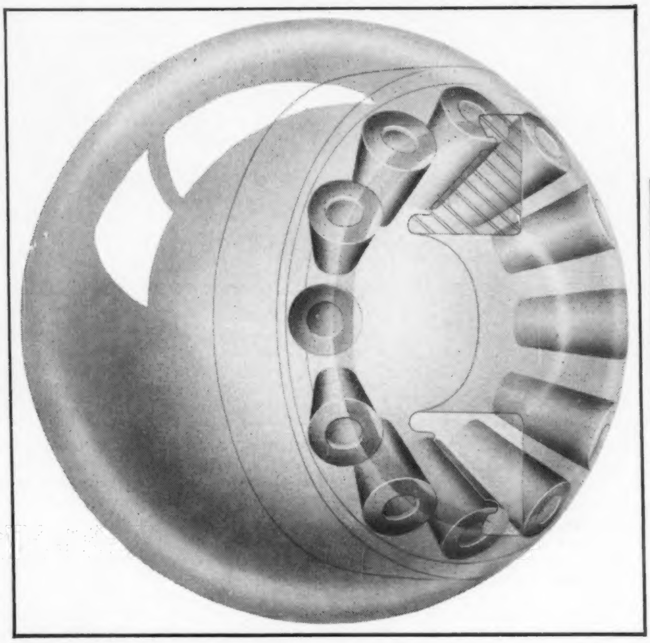
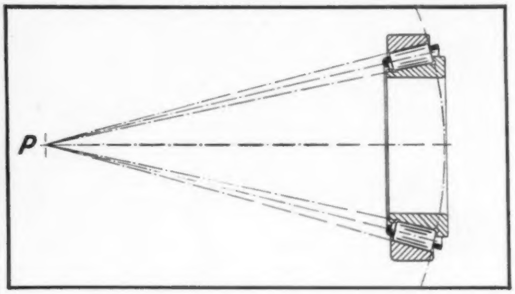
One in a series of technical reports by Bower

BEARING BRIEFINGS

SPHERICITY—ESSENTIAL TO MAXIMUM BEARING PERFORMANCE



When you require bearings, we suggest you consider the advantages of Bower bearings. Where product design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in a full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.



True rolling of tapered bearing elements depends upon maintaining a true spherical radius during manufacture.

For a tapered roller bearing to achieve maximum performance, i.e., maximum life and capacity under load, it must have true sphericity — a condition of bearing geometry which permits true rolling of the tapered rollers in the raceway.

True rolling in tapered bearing elements is the result of maintaining a critical geometric relationship between the raceways and the contact surfaces of each roller. True rolling is essential to maximum performance. Without it, premature bearing failure is certain.

As engineers know, a tapered roller will describe a true circle when rolled on a plane surface. *It will always roll in this one path precisely, without sliding or skewing.* But to put true rolling to work in a bearing which can carry both heavy thrust and radial loads, it is essential that the rollers *and* the raceway have a true spherical radius, or sphericity. The drawing illustrates this condition.

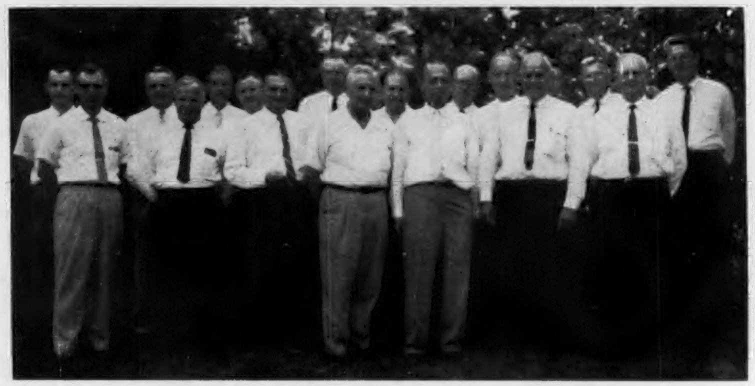
If each roller in the bearing were to be extended in length, while retaining its taper, it would form a cone, terminating at point "P". All cones generated from all rollers would meet at point "P", which is also the center of the hypothetical sphere shown. The surface of the sphere would *touch all points on each roller's head!*

In effect, then, each roller's taper determines the radius of a hypothetical sphere whose surface, in turn, determines the correct contour for each roller head. Only when these conditions are satisfied in design, and when they are rigidly held during manufacture, will true rolling take place. In the manufacture of each Bower tapered roller bearing, sphericity is held within extremely narrow limits by means of special Bower-designed precision grinders. The consistent accuracy possible with these machines is one major reason why Bower roller bearings provide maximum performance under all speeds and loads up to the bearing's maximum rating.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION — FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

Electric Utilization Research Corporation Committee Meets



The ASAE Electric Utilization Research Conference Committee met September 3, at the Agricultural Engineering Laboratory, USDA Research Center, Beltsville, Md., to probe the needs in farm electrification research. The committee meets annually at Beltsville for this purpose and to review the work in progress. Chairman W. J. Ridout, Jr., reported that 14 of the 20 members of the committee were present.

In attendance were *(left to right)* M. Conner Ahrens, (ARS) USDA; Lowell J. Endahl, National Rural Electric Cooperative Assn.; H. S. Pringle, Extension Service, USDA; J. P. Ditchman, General Electric Co.; Harold H. Beaty, University of Illinois; W. J. Ridout, Jr. (chairman), Electricity on the Farm Magazine; E. T. Swink, Virginia Polytechnic Institute; Price Hobgood, Texas A. and M. College; E. G. McKibben, chief, Agricultural Engineering Division, (ARS) USDA; B. C. Reynolds, State Experiment Stations Division, (ARS) USDA; Truman E. Hienton, head, Farm Electrification Branch, (AERD-ARS) USDA; J. C. Cahill, Detroit Edison Co.; M. O. Whithed, Edison Electric Institute; June Roberts, State College of Washington; (partially hidden) W. E. McCune, Texas A. and M. College; Dean L. Searls, Adams Electric Cooperative; S. P. Lyle, Federal Extension Service, USDA; and W. C. Wenner, Northwestern Rural Electric Cooperative. Ahrens, McKibben, McCune, and Lyle were guests of the committee.

Engineers Joint Council Offers New Publication

In its expanding service to the nation's engineers and its own member societies, Engineers Joint Council offers a new publication, "Engineer." This newsletter will bring together news emanating from many sources into a single, comprehensive digest for engineers. "Engineer" made its debut in September, and will be published at least nine times a year. EJC will accept subscriptions—without charge—from any individual member of participating engineering societies who requests it through its office. To be placed on the mailing list to receive "Engineer" address Engineers Joint Council, 29 W. 39th St., New York 18, N. Y. (This is an added service to ASAE members and their opportunity to receive current information on over-all engineering professional matters.)

Fellowships

Four Graduate Fellowships have been announced by the Foundation for Cotton Research and Education. The recipients are: Ivan W. Kirk, Lark, Texas; Joe E. Clayton, Tellar, Ark.; W. E. Seigler, Wagner, S. C.; and F. S. Wright, Grover, N. C. They began their graduate studies this fall.

Drainage Conference — December 14-15

The Mason City Brick and Tile Co. is again sponsoring the annual Drainage Conference, December 14 and 15, 1959, at the Hanford Hotel, Mason City, Iowa. A program on "drainage progress" is being scheduled, with speakers discussing the progress of equipment, drain tile, drainage plans and drainage structures.

Seek Instrumentation Papers for 1960 Annual Meeting

Papers are now being sought for an Instrumentation Session at the June 1960 Annual Meeting. If you have a paper on an instrumentation development or application which can be prepared for presentation at this meeting, the title and author should be forwarded to K. H. Norris, Administration Building, Plant Industry Station, Beltsville, Md., prior to December 10. The Instrumentation Committee will review all titles at its meeting in December to set up the program for June.

Dana Corporation Has New Division

Announcement is made by John E. Martin, president of Dana Corp., of the creation of a new division to carry on the manufacture of Rzeppa constant velocity universal joints. It is known as the Con-vel Division and brings the number of such units and wholly-owned subsidiaries operated by Dana Corp. up to 12. The new division will remain in its present location in Detroit, Mich. Acquisition by Dana of the Rzeppa assets of Gear Grinding Machine Co. occurred in May, 1959.

New Addition to Ag Engineering Building at N. C. State College

Construction will begin soon on the new addition to the existing agricultural engineering building at North Carolina State College. The new addition will include an administrative unit, approximately 15 new offices for research and teaching personnel, and greatly expanded classroom, laboratory, and shop facilities. All agricultural engineering personnel, including extension, will be brought together in this new facility.

Scholarships

Two $200 ASAE scholarships have been awarded for North Carolina State College. The recipients are Clemon Elton Bass, Jr. and Robert Cooke. Mr. Bass, whose home is in Edenton, N. C., will enroll in agricultural engineering at North Carolina State this fall, and Mr. Cooke of Huntersville, N. C., is a rising junior in agricultural engineering. These scholarships are sponsored by the North Carolina Section of ASAE and are awarded each year to deserving students in agricultural engineering science or technology.

The first "Special Name" scholarship in agricultural engineering at North Carolina State College has been established and awarded for the 1959-60 school year to Shelton Young Adcock, a rising junior. This scholarship, known as the Surtman Foundation Scholarship in agricultural engineering, was made possible by J. R. Surtman, president of Carolina Ford Tractor Co. The recipient normally shall be a rising sophomore in the agricultural engineering science or technology curriculum, but since no suitable candidate could be found in the rising sophomore group this year, Mr. Adcock was selected on the basis of his scholastic achievement, his active participation in ASAE, and his need of financial assistance. The scholarship will provide $300 during the next school year. *(Continued on page 624)*

EVENTS CALENDAR

October 19-22 — *National Retail Farm Equipment Association's* Annual Convention, Philadelphia. Contact National Retail Farm Equipment Association, 2340 Hampton Ave., St. Louis 10, Mo., for details.

October 20-22 — *Sixth Annual Conference on Lubrication,* jointly-sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, Sheraton-McAlpin Hotel, New York City. American Society of Lubrication Engineers, 5 N. Wabash Ave., Chicago 2, Ill., may be contacted for further information.

October 20-22—*Tenth National Conference on Standards,* Sheraton-Cadillac Hotel, Detroit, Mich. Write to American Standards Association, Inc., 70 E. 45th St., New York 17, N. Y., for details.

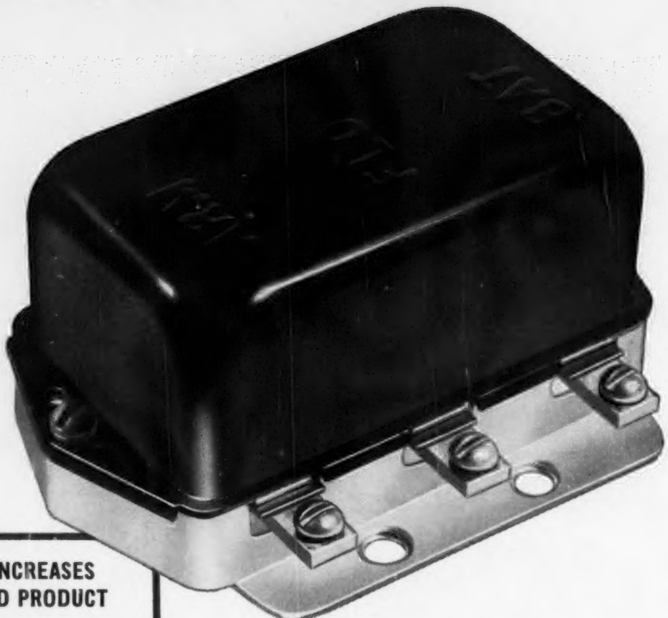
October 22-23—*15th Annual National Conference on Industrial Hydraulics,* Sherman Hotel, Chicago, Ill., sponsored by Illinois Institute of Technology. For information address Ray D. Meade, Conference Secretary, 3300 S. Federal St., Chicago 16, Ill.

October 26-30 — *Society of Automotive Engineers, Inc.* National Meetings for Fuels and Lubricants, Transportation, and Diesels, Hotel LaSalle, Chicago, Ill. Contact SAE headquarters, 485 Lexington Ave., New York 17, N. Y., to obtain information.

November 16-18 — *Structural Clay Products Institute's* Silver Anniversary Convention, Greenbrier Hotel, White Sulphur Springs, W. Va. For further information contact SCPI, 1520 18th St., N.W., Washington 6, D.C. *(Continued on page 624)*

NOW... FROM AUTOLITE

A NEW VOLTAGE REGULATOR WITH INTERCHANGEABLE POLARITY



Autolite VBO Regulator eliminates need to select correct polarity . . . protects against damage due to incorrect polarity.

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The exceptionally high quality of Autolite electrical products has been unquestioned for generations. Because of this, many of America's largest manufacturers continue to add sales appeal and dependability to their products by specifying Autolite equipment. The Autolite quality that these companies have come to expect starts in well-equipped laboratories and is backed by a highly skilled service organization whose facilities are available wherever dependable Autolite products are sold.

The VBO is a different regulator, insensitive to polarity, incorporating the best features of previous designs and with many new improvements. It is more rugged, more resistant to vibration, and it has better under-base insulation to reduce electrical creepage. Other Autolite quality features of this new regulator are:

1. Either silver alloys or pure tungsten contacts are used—whichever is best for application.
2. New design retains accurate calibration.
3. Thermal metal hinges employed in place of magnetic shunt provide correct compensation at both extreme high and low temperatures.
4. Contacts are attached directly to both the moving and stationary members on standard regulators, giving needed rigidity and eliminating reeds.

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Michigan Section

On Saturday, October 24, the fall meeting of the Michigan Section will be held in cooperation with the homecoming activities at Michigan State University. The meeting will be held in Room 116 of the Agricultural Engineering Building, and will open with a welcome by A. W. Farrall, head of the agricultural engineering department. Papers on making soils from sand; latest reports on a tomato harvester; and grain drying with solar heat will follow. The ladies program will include 10 o'clock coffee and a book review. Lunch for both members and their wives will be served at noon in the South Campus Cafeteria, after which they may attend the Michigan State-Indiana football game.

Kentucky Section

The Kentucky Section will hold a fall meeting at Mammoth Cave National Park on October 30-31. Friday evening, October 30, has been designated for registration and get acquainted time. A group breakfast will be served on Saturday morning, after which members will hear an explanation of watershed projects covered by Public Law 566. The remainder of the morning will be spent on a tour of the Mud River Watershed. Families will be included at the luncheon which will be served at the Diamond Cavern Lodge. The business meeting will be held in the afternoon, followed by an explanation and a tour of Dr. Elwood Rawsey's farm to observe an interesting swine enterprise. Cave tours will complete the afternoon's activities.

Oklahoma Section

The fall meeting of the Oklahoma Section will be held in Stillwater, December 4, 1959. A well-rounded program that should be of interest to all members is being planned. Speakers will be limited in time to assure short, to-the-point talks and allow a maximum number of topics to be presented. Topics will include: Planning and construction on the watersheds for upstream flood prevention; machinery for conservation; materials handling and other topics of current interest. The program also includes an outstanding luncheon speaker and the election of officers for the coming year. For the sports-minded members, the Cowpokes of Oklahoma State University meet Baylor University the night of December 4 at Gallagher Hall. Tickets for this basketball game can be obtained by writing to the Athletic Office, OSU Campus, Stillwater.

South Carolina Section

The first summer meeting of the South Carolina Section was held at 4-H Camp Bob Cooper near Manning on August 27 and 28. The technical part of the program was short but interesting. H. E. McLeod, assistant professor of agricultural engineering, Clemson College, gave a stimulating presentation of "Similitude in Agricultural Engineering Research" which was followed by an equally interesting and enlightening paper entitled "Mechanical Harvesting of Tobacco," by W. E. Splinter, who is associate research professor, North Carolina State College.

ASAE MEETINGS CALENDAR

October 22-23 — ALABAMA SECTION, Enterprise, Ala.

October 24—MICHIGAN SECTION, Michigan State University, East Lansing.

October 30 — KENTUCKY SECTION, Mammoth Cave National Park.

November 13-14—GEORGIA SECTION, Georgia Center for Continuing Education, Athens.

December 4 — OKLAHOMA SECTION, Stillwater.

December 16-18 — WINTER MEETING, Palmer House, Chicago, Ill.

February 1-3 — SOUTHEAST SECTION, Birmingham, Ala.

April 14-15 — PACIFIC COAST SECTION, Arrowhead Conference Center of the University of California.

June 12-16—ANNUAL MEETING, Ohio State University, Columbus, Ohio.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

The third and final paper on the afternoon program was "Engineering and Hydrology Phases of Public Law 566," capably handled by J. L. Aull, state conservation engineer, Columbia, S. C. Following the technical program was a short business session, after which everyone joined the recreational activities, primarily swimming. Men and ladies, alike, were interested in the after-dinner address "Why Nuclear Power," by A. C. Thies, assistant to manager of production and transmission, Duke Power Co., Charlotte, N. C. Mr. Thies pointed out the progress made in power generation during the past twenty years and emphasized the importance of continued research aimed at producing more power, more efficiently in the future. On the morning of August 28, the men visited the giant Portland Cement Manufacturing Plant at Harleyville, S. C., to observe the cement manufacturing process.

Pacific Coast Section

Arrangements have been completed to hold the 1960 Annual Meeting of the Pacific Coast Section on April 14 and 15 at the Arrowhead Conference Center of the University of California. This mile-high Center is located on the north shore of Lake Arrowhead, in the San Bernardino Mountains. There will be separate and concurrent technical sessions on soil and water and on agricultural mechanics (combining power and machinery, farm structures, and electric power and processing). Where strong interest is shown in some of these latter fields, further subdivision by interest may be arranged.

Central Illinois Section

The fall meeting of the Central Illinois Section will be held Thursday, November 5. The place is Sinorak, 1720 South Main Street, Bloomington, Ill., and the time for registration is 6:15 p.m., with the program scheduled to follow the 6:45 p.m. dinner. An educational and entertaining evening is planned, and Martin T. Ekovich, assistant state conservationist, SCS, USDA, will speak on the small watershed program in Illinois. Other program details will be announced later. Section members have been given an S-O-S (Stimulate-Our-Section) by the secretary, Gene Shove, to bring a guest to the meeting, and interest an acquaintance in ASAE membership.

. . . News

(Continued from page 620)

1959 Feed Production School and Small Mill Short Course

The 1959 Feed Production School and Small Mill Short Course were held, respectively, Sept. 23 through 25, and Sept. 26, at the Continental Hotel, Kansas City, Mo. This year's program featured "Pelleting" and included discussions on roughage pelleting, pelleting complete rations, and related pelleting subjects, as well as other pertinent subjects of interest. John B. Dobie, agricultural engineer, University of California, and an ASAE member, was included in the daytime session on Wednesday, Sept. 23, his subject being "A Research Engineer Looks at Roughage Pelleting and Wafering"; he also spoke on Wednesday evening on the technical aspects of research projects. The Small Mill Short Course on Saturday, Sept. 26, was designed to meet the needs of the smaller mill operator. Over 800 students from various phases of the feed manufacturing industry were in attendance for the three-day school. John Wessman, director of activities for the Feed Production School, and member of ASAE, reports that at least 22 ASAE members attended the sessions.

BULLETIN

As the Journal goes to press word has been received that George E. Pickard, professor of power and machinery, agricultural engineering department, University of Illinois, passed away on October 3, 1959. Further details will be carried in November issue.

Ten ASAE Sections Meet Motion Picture Quota

A total of ten ASAE Sections have completed payment on their respective quotas for the ASAE motion picture fund. Latest to join the list of paid-up Sections are Connecticut Valley, Florida, West Virginia, and Southwest (including Baton Rouge and Oklahoma). Since the Baton Rouge and Oklahoma Sections are within the geographical boundaries of the Southwest Section the latter absorbed the quotas of the first two Sections together with its own quota. Others reported earlier are Quad City, Washington, D.C., Pennsylvania and Tennessee Sections. In addition to meeting their quotas, the Quad City, Connecticut Valley, West Virginia and Southwest-Baton Rouge-Oklahoma Sections actually oversubscribed — one as much as 24 percent.

Robert G. Morgan, chairman of contributions from ASAE Sections, reports that over 85 percent of the total quota of $8,000 has been accepted in full or in part, and that 24 percent already has been received at ASAE headquarters. Since the original target date was established as October 1, he urges those Sections that have not met their quotas to do so at their earliest convenience.

Will Brooks, plant manager, Illinois Farm Supply Co., Springfield, Ill., and John B. Dobie, Dept. of Agricultural Engineering, University of California, Davis, were speakers at the recent Feed Production School held in Kansas City, Mo.

Agricultural Engineering Dictionary Progressing

During the past year much has been accomplished toward the preparation of the Agricultural Engineering dictionary. The Agricultural Engineering Department at Michigan State University, East Lansing, with the help of many agricultural engineers throughout the country, is spearheading the job. According to A. W. Farrall, head of the department, the dictionary is a nonprofit project with its only objective to make a worthy contribution to the agricultural engineering profession. The primary definitions for some 15,000 words and terms have been written to date and about 10 percent, or 1500 of these, have been reviewed by cooperating editors. Mr. Farrall states that, by their cooperation, these editors, who are agricultural engineers in industry and education throughout the United States, will make it possible to produce an authoritative book.

It is hoped that all definitions will be edited early in 1960. In order that this might be done, however, additional cooperating editors are urgently needed. Any agricultural engineer, who is interested in editing definitions in batches of 25 to 30 at a time, is invited to contact the Journal, AGRICULTURAL ENGINEERING, or the Agricultural Engineering Department at Michigan State University.

Symposium Arranged for AAAS Section O — Agriculture — Meeting

Section O (Agriculture) of the American Association for the Advancement of Science has arranged a Symposium program entitled "Germ Plasm Resources for Agriculture: Development and Protection" for presentation at its annual meeting December 28 to 31, 1959. The meeting place is Exhibit Hall (South), Morrison Hotel, Chicago, Ill. The symposium will consist of five sessions: I — Origin of germ plasm; II — Need for and utilization of additional sources of germ plasm; III — Developmental programs in crops and livestock; IV—New approaches to plant and animal improvement; and V — Perpetuation and protection of breeding stocks. A limited number of copies of the complete program may be obtained from American Society of Agricultural Engineers, 420 Main St., St. Joseph, Mich.

. . . Events Calendar

(Continued from page 620)

November 18-20 — Sixth Annual *National Electric Farm Power Conference,* Westward Ho Hotel, Phoenix, Ariz. For additional information write to Inter-Industry Farm Electric Utilization Council, Inc., P.O. Box 577, Washington 4, D.C.

December 2-4 — 46th Annual Convention of the *National Warm Air Heating and Air Conditioning Association, Chase-Park* Plaza Hotel, St. Louis, Mo. Detailed information may be obtained from the association headquarters at 640 Engineers Building, Cleveland 14, Ohio.

December 7-11—*Smithfield Show and Agricultural Machinery Exhibition,* London, England. Further details may be obtained from British Information Services, New York Offices, 45 Rockefeller Plaza, New York 20, N. Y.

December 14-15 — *Drainage Conference,* Hanford Hotel, Mason City, Iowa. For further details, contact R. L. King, P. E., Mason City Brick and Tile Co., Mason City, Iowa.

December 26-31—*American Association for the Advancement of Science,* 126th Meeting, Chicago. Section M (Engineering) will meet December 28-29. Section O (Agriculture) will meet December 28-31. Contact AAAS, 1515 Massachusetts Ave., N.W., Washington 5, D.C., for additional information.

December 28-31 — *American Association for Advancement of Science, Section O — Agriculture,* Exhibit Hall (South), Morrison Hotel, Chicago, Ill. Write to: Howard B. Sprague, Secretary, Section O, AAAS, Dept. of Agronomy, Pennsylvania State University, University Park, Pa.

January 14-15 — *Annual Cotton Production Conference,* Memphis, Tenn., jointly-sponsored by the Cotton Mechanization Conference and the Farm Equipment Institute. Write to FEI, 608 S. Dearborn St., Chicago 5, Ill., for information.

January 21-22—13th Annual *Southern Farm Forum,* Roosevelt Hotel, New Orleans, La., sponsored by the Agricultural Committee of the Chamber of Commerce of the New Orleans area. For details write to SFF, P.O. Box 1460, New Orleans, La.

January 25-28 — *Plant Maintenance and Engineering Show,* Convention Hall, Philadelphia, Pa. Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y., will furnish additional information.

January 25-29 — *Stress Measurement Symposium,* Arizona State University, Tempe, Ariz., sponsored by Strain Gage Readings. Further details may be obtained by writing to Peter K. Stein, Editor, Strain Gage Readings, 5602 E. Monte Rosa, Phoenix, Ariz.

February 1-3 — *Association of Southern Agricultural Workers,* 57th Annual Meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala. For information write to C. E. Kemmerly, Jr., Secretary-Treasurer, Louisiana State University, Baton Rouge, La.

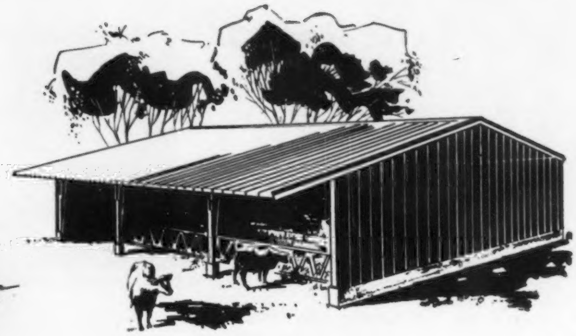
February 1-4— *American Society of Heating, Refrigerating and Air-Conditioning Engineers,* Semiannual Meeting, and the *Second Southwest Heating and Air-Conditioning Exposition,* Memorial Auditorium, Dallas, Texas. To obtain details contact ASHRA headquarters, 62 Worth St., New York 13, N. Y.

February 2-4 — *Fifteenth Society of the Plastics Industry's Reinforced Plastics Division Conference,* Edgewater Beach Hotel, Chicago, Ill. For additional information write to SPI, 250 Park Ave., New York 17, N. Y.

March 1-6 — *31st Salon International De La Machine Agricole (Agricultural Machinery Show),* Paris, France. Additional information will be furnished by the Commercial Counselor, French Embassy, 610 Fifth Ave., New York 20, N. Y.

April 18-20 — *Seventh National Watershed Congress,* Washington, D.C. Write to The National Association of Soil Conservation Districts, Service Dept., League City, Texas, for further details.

September 6-16 — *Production Engineering Show,* Navy Pier, Chicago, Ill. Will run concurrently with *Machine Tool Exposition.* Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y., may be contacted for complete information.



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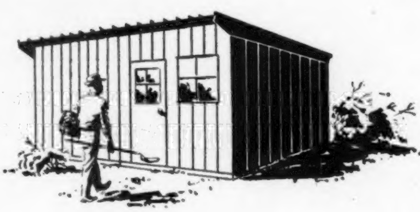

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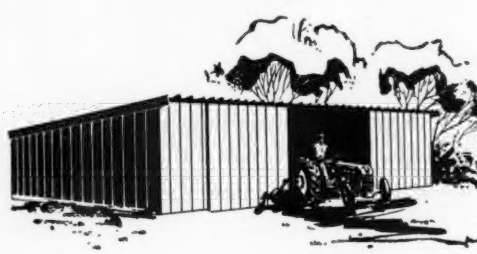

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ASAE MEMBERS IN THE NEWS

K. M. Hickman

L. H. Hodges

D. W. Turnbull

L. Terry

Kendrick M. Hickman, assistant sales manager of Link-Belt Company's Ewart plant in Indianapolis since 1952, has been promoted to sales manager. He began his career with the company at the Ewart plant in 1927 and served in the Chicago and Detroit offices before returning to the plant in 1946. He was appointed manager for agricultural sales in 1950.

Lawrence H. Hodges has been promoted to a top position in central engineering at J. I. Case Co. headquarters in Racine, Wis. He held the position of design and research engineer with the company at Rockford, Ill., from 1952 to 1955, when he was promoted to chief product engineer. Early this year he was promoted to works manager.

Dale W. Turnbull, district representative in Oklahoma and Kansas for Caterpillar Tractor Co. since 1955, has been promoted to supervisor of wheel tractors and motor graders of the company's product section of the Product Division. In his new position he will have responsibility for working with owners in assessing production of current machines and development of new equipment and attachments. Prior to 1955, he had been connected with the company's Plains Sales and Sales Development Divisions.

LeGrand Terry has been recently appointed as eastern regional sales manager of the Mobile Hydraulics Division, Vickers Inc., Division of Sperry Rand Corp. His new responsibilities will include mobile sales supervision of a 24-state area from the midwest section of the country to the eastern seaboard. He has worked with mobile hydraulics products since joining the company in 1951 as an application engineer. Previous to his new appointment he was the Detroit office district manager of the company's Mobile Hydraulics Div.

Walter B. Schumacher has accepted a position with Aerovent Fan and Equipment, Inc., Piqua, Ohio, as a project engineer. He was previously connected with New Holland Machine Div. of Sperry-Rand Corp., as a designer.

Julian L. Chalk, formerly with the fluid and power plant systems test laboratory of Chance-Vought Aircraft Inc., in Texas, as a hydraulic and pneumatic test engineer, is now associated with the Lakeshore Div., Bendix Aviation Corp., St. Joseph, Mich., as an engineer.

Edward L. Stout, who recently finished a tour of duty with the armed forces, has accepted a position in the engineering research department of Ford Tractor and Implement Co., Birmingham, Mich.

Richard N. Fenzl advises that he is now on the staff of the department of irrigation, University of California, Davis. He formerly held the position of assistant professor of agricultural engineering at Cornell University.

Douglas K. Moore has been transferred from his position of agricultural engineer for Collier Carbon and Chemical Corp., at Brea, Calif., to its district sales manager with headquarters in Hilo, Hawaii.

Leslie E. Oglesby has been promoted and transferred by International Harvester Co. from sales promotion supervisor at its Jacksonville, Fla., district office to assistant district manager at its Atlanta, Ga., district office.

Robert I. Paine recently became vice-president of Agri-Industries, Inc., a newly formed sales and engineering corporation, located in Wharton, Texas. The primary intent of this corporation is to furnish the farmer and the livestock feeder engineered grain storage facilities and automatic feeding systems. He formerly held a position as research engineer for the McRan Co.

Ernest T. Smerdon has accepted a position as an associate professor in agricultural engineering at Texas A. & M. College. He previously was on the staff of the University of Missouri as an instructor in the agricultural engineering department.

Carl J. Turner, who has been assistant to the director at the South Carolina Experiment Station, Clemson, has been promoted to assistant director. Prior to his assignment as assistant to the director earlier in 1959 he was assistant agricultural engineer at the Station.

John Peterson has accepted a position as instructor of civil engineering with the University Extension Division of The University of Wisconsin. His duties involve handling of correspondence courses and on-campus engineering institutes. He received an M.S. degree in civil engineering from The University of Illinois in 1959. During 1957 and 1958 he was an instructor in agricultural engineering at Kansas State College.

(Continued on page 628)

NECROLOGY

Howard M. Railsback, director of advertising for Deere & Company for 36 years prior to his retirement in 1953, died August 18 in Hackley Hospital at Muskegon, Mich. He had been vacationing at Michillinda, Mich., where he became ill and was taken to the hospital just a week prior to his death. Burial was in Moline, Ill., on August 21. He was 74 years old at the time of his death. Following graduation from the University of Illinois in 1911, he joined Deere & Company's advertising department and became director of the department in 1917. He was responsible for the annual "John Deere Days," which are staged by dealers each winter and under his direction, the company's bi-monthly farm publication, "The Furrow," developed into an outstanding advertising promotion in the farm equipment field. He had been a member of ASAE since 1918 and was made a Life Member in 1953. He is survived by his wife, Eve; a son, George; a daughter, Mrs. George F. Neiley, Jr. of Moline, Ill.; three grandchildren, Cynthia, Timmy, and Nancy Neiley, and a brother, Fred, a Moline lawyer.

Howard M. Railsback

John E. Nicholas, professor emeritus of agricultural engineering, Pennsylvania State University, died unexpectedly while vacationing at Sagamore Beach, Mass., on September 15, 1959. Professor Nicholas retired July 1, 1958, after serving on the faculty of Penn State for nearly 30 years. He received a B.S. degree in mechanical engineering from Lehigh University in 1915 and an M.S. degree in mechanical engineering from the Massachusetts Institute of Technology in 1926. He served as a mechanical engineer with Bethlehem Steel Corp. from 1915 to 1921 and then served on the faculty of the University of Illinois, Rice Institute, Massachusetts Institute of Technology, and University of Minnesota before his appointment at Penn State in 1929. His work at Penn State was concerned with the application of electricity to agriculture and he published more than 100 papers on his work. He was widely known for his research in the freezing of food, also on milk cooling. He had been a member of ASAE since 1932 and elected to the grade of Fellow in 1951. He had been active in the North Atlantic Section and had also served on many important committees at the national, regional, and state levels. He also held memberships in the American Society of Refrigeration Engineering, American Institute of Food Technologists, American Society for Engineering Education, Society of Sigma Xi, and Gamma Sigma Delta, agricultural honor society. For many years, he had been a vestryman at St. Andrew's Episcopal Church in State College, Pa. His wife survives, as do three sons, Richard C., East Lansing, Mich.; Dr. W. Channing, Bismarck, N. D.; and Bruce O., Harrisburg, Pa.

John E. Nicholas

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"Live" hydraulic power keeps raising loader fork as you clutch or shift to shorten the loading cycle. This high-volume hydraulic power gives McCormick® loaders tremendous break-away lift . . . helps you load big spreaders minutes faster. You power-steer your way in and out of tight spots and across deep ruts with one-handed ease. And faster tractor speeds and bigger-capacity McCormick spreaders help you spread tons more manure in a shorter day!

Clean low sheds and tight corners easily with low-profile International® 240 Utility, and close-coupled McCormick No. 20 loader. This rugged loader lifts 900 lb . . . dumps fork clean at nearly 8-foot height. Tidy up quickly with handy rear blade. You control this blade precisely with Tel-A-Depth.

Power-load a 95-bushel spreader in a hurry with this International 340 Utility tractor and a McCormick No. 34 loader. Even in cramped and muddy lots, IH power steering, 2-way control of bucket and boom, and optional Fast Reverser cut loading time way down to help you move tons more manure daily.

Haul more loads in a day with faster transport speeds. Torque Amplifier drive gives Farmall tractors two road speeds. You can start a heavy load like this 95-bushel McCormick No. 31 spreader in 5th-TA, and when the load is rolling, *instantly* step up to 16½ mph without shifting gears.

Power-away your loading and hauling jobs fast with IH tractors and McCormick equipment to gain extra field time worth hundreds of dollars. See your IH dealer for more facts, and a good deal!

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. . . Members in the News

(Continued from page 626)

William G. Searles, formerly senior designer with New Holland Machine Division, The Sperry Rand Corp., recently has accepted the position of chief engineer with Interurban Industries Division of Union Fork & Hoe Co., Indianapolis, Ind.

Dalton S. Harrison, immediate past-chairman of the Florida Section of ASAE, recently has joined the staff of the University of Florida, Gainesville, as an extension agricultural engineer. He formerly was with the Everglades Experiment Station at Belle Glade, Fla.

L. O. Drew has been transferred from his position as an agricultural engineer with International Cooperation Administration in Beirut, Lebanon, to a new mission with ICA as chief agricultural engineering advisor in Karachi, Pakistan. He spent three and one-half years in the Beirut position and previous to that time was associate professor of agricultural engineering at the University of Georgia.

Robert G. Holmes has been appointed midwestern representative for Acme Chain Corp. with headquarters in Chicago and will handle its entire product line in this area. Prior to accepting his new position, he had been midwest regional sales manager for Morse Chain Co.

H. E. McLeod, of the agricultural engineering department of Clemson College, Clemson, S. C., recently has received a Ph.D. degree from Iowa State University. Presently he is teaching courses in Power and Machinery.

Warren E. Kruger, formerly an engineer with Caterpillar Tractor Co., is now connected with the U.S. Bureau of Reclamation in Minot, N. D., as an engineer. He had been associated with Caterpillar since his graduation from Montana State College in 1954.

Frederick L. Hotes is now connected with Engineering-Science, Inc., Oakland, Calif., as manager of the San Francisco area office and chief of the Land and Water Resources Development. He formerly was associated with Development and Resources Corp. of New York City.

W. L. Sparkman, formerly an agronomist with Atlantic Land and Improvement Co. of LaBelle, Fla., is now assistant general superintendent of Dixie Lime Products, Inc., Ocala, Fla.

Norman L. Slack, formerly a test engineer at LeTourneau-Westinghouse Corp., is now associated with the Tractor and Implement Division of Ford Motor Co. as a product development engineer.

Cornelius Chung-sheng Shih advises that he has accepted a position with Alabama Polytechnic Institute as an associate professor in the civil engineering dept. Prior to joining the API staff he was a graduate research assistant in agricultural engineering at Michigan State University.

Charles W. Doering, formerly a project engineer with Minneapolis-Moline Co., has accepted a position with International Harvester Co. as project engineer.

Raymond C. Mitzner recently has become associated with Douglas Fir Plywood Assn. of Tacoma, Wash., as an agricultural engineer. He previously was with Rilco Laminated Products Co., Inc., St. Paul, Minn., as an engineer.

Richard L. Wawrzyniak is now connected with Farm Fans Division, Ewing Foundry, Inc. in Indianapolis, Ind. Until this recent change, he was an agricultural engineer with the Soil Conservation Service, USDA.

Ellis S. Nestor, rural engineer with Virginia Electric & Power Co., has been transferred to the company's Petersburg office. He will be engaged in industrial work rather than rural engineering in his new position.

Easley S. Smith, assistant extension agr. engr., Virginia Extension Service, Virginia Polytechnic Institute, recently has completed graduate requirements for an M.S. degree in agricultural engineering. His thesis work consisted of a study of hay conditioners.

J. P. Dail, Jr., former manager of Farm Equipment Dept., General Metals, Inc., Greensboro, N. C., has been named general manager of the same division.

James C. Hansen has accepted a position as farm director of radio station KOMO in Seattle, Wash. He received a B.S. degree in agricultural engineering in 1959 from the State College of Washington.

M. J. Morgan has resigned from the agricultural engineering department of the State College of Washington to accept an overseas mission as an agricultural engineering advisor with the Internal Cooperation Administration, in Khartoum, Sudan.

Kenneth K. Barnes has accepted a position with the University of Arizona, Tucson, as professor of agricultural engineering and agricultural engineer in the agricultural experiment station. Prior to his new position, he was professor of agricultural engineering, Iowa State College, Ames.

Getting the Most Out of Frozen Foods (Circular 562), and *1959-1960 Spray Schedules for Commercial Fruit Plantings* (Circular 544A). Co-operative Extension Service, Agriculture and Home Economics, University of Kentucky, Lexington, Ky.

Third Annual Progress Report of the Farm Electric Utilization Project, by K. L. McFate, project director. May 1959. Agricultural Engineering Dept., The University of Missouri, Columbia, Mo.

Wood Screws for Building Construction and Wood Products Assembly, by E. George Stern. Bulletin No. 39, May 1959. Virginia Polytechnic Institute, Wood Research Laboratory, Blacksburg, Va.

Seed-Cotton Input Control for Gins, by A. C. Griffin, Jr. and O. L. McCaskill. Production Research Report No. 29. June 1959. Price, 10 cents. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.

Johnson Grass Control: A Farm and County Program. Progress Report 78. Agricultural Experiment Station, The University of Kentucky, Lexington, Ky.

Agricultural Aviation. Quarterly periodical. Subscription rate per year, $3.50. European Agricultural Aviation Center, le v.d. Boschstraat 4, The Hague, Netherlands.

Farm Irrigation Structures: Plastic Film Ditch Liners, J. A. Corry and D. R. Fox. Bulletin. Agricultural Extension Service, University of California, Davis, Calif.

Farming on the Contour, by R. C. Hay and B. A. Jones, Jr. Circular 806. Agricultural Engineering Dept., University of Illinois, Urbana, Ill.

Experimental Irrigation of Ladino Clover-Grass Pasture, by G. E. McKibben, L. E. Gard, R. J. Webb, H. A. Cate, and B. A. Jones, Jr. Bulletin 640. Agricultural Engineering Dept., University of Illinois, Urbana, Ill.

A Problem Analysis and Program for Watershed-Management Research in the White Mountains of New Hampshire, by G. R. Trimble, Jr. Station Paper No. 116. 1959. Northeastern Forest Experiment Station, 102 Motors Ave., Upper Darby, Pa.

A New Concept in Sprinkler Irrigation, by G. M. McMaster. Progress Report No. 17. April 1959. Agricultural Experiment Station, College of Agriculture, University of Idaho, Moscow, Idaho.

Care of Household Electrical Equipment, by D. W. Works. Farm Electrification Leaflet No. 46. June 1959. Extension Division, College of Agriculture, University of Idaho, Moscow, Idaho.

Proceedings of The First Japan Congress on Testing Materials. 147 pages. 1958. The Japan Society for Testing Materials, Kyoto, Japan.

USSR Patents and Inventions (English translation of Soviet Bulletin and Abstracts Journal). Published 24 times per year. Subscription rate per year, $150. Pergamon Press Inc., 122 E. 55th St., New York 22, N. Y.

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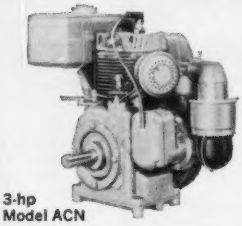

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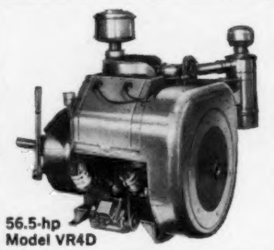
Model ACN



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then you can derive much benefit from membership in ASAE, and the Society cordially invites you to make application. For further information write

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
St. Joseph, Michigan

MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Diesel Crawler Tractor

Allis-Chalmers Mfg. Co., Construction Machinery Div., Milwaukee 1, Wis. — A 16-page bulletin (MS-1251) describing the company's diesel-powered crawler tractor. Includes pictures, graphs, charts and other illustrations, including accessories designed and engineered for increasing the tractor's versatility. Specifications are included.

Force Control Switch

Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill. — An 8-page bulletin describing subminiature switches which are used in a line of force-control switches designed for automatic and accurate control of mechanical forces at various load points.

Custom Steel

Midvale-Heppenstall Co., Nicetown, Philadelphia 40, Pa. — A 24- page illustrated brochure entitled "Custom Steel Makers to Industry" is one of the latest booklets on the production of forgings and alloy steel for industry.

Rubber Mounted Machines

Koehring Div., Koehring Co., 3026 W. Concordia Avenue, Milwaukee 16, Wisconsin — An illustrated 12-page, 2-color catalog with a special section devoted to the rubber-mounted truck and cruiser chassis and upper machinery assemblies. A "standard equipment" section tells about pendant boom suspension, telescopic boom limit stops, automatic power boom lowering and torque converter drive. The "optional equipment" section includes jib boom extensions, power load lowering, third drum, and independent lighting plant.

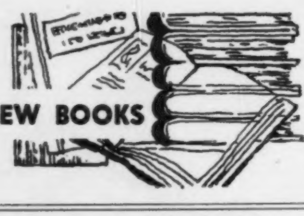
Processing Equipment Bulletin

The Bauer Bros. Co., Springfield, Ohio — Processing equipment for various industries is described and illustrated in four-page, two-color bulletin No. 59. Equipment shown for use in pulverizing, fiberizing, granulating and blending various materials includes hammer mills, double and single disc attrition mills, single and double roll crushers and magnetic separators. Cleaning, separating, dehulling, and delinting equipment for the oil milling and asbestos industries, as well as roasters, grinders, texturizers, cooling cars and tables, cleaners, classifiers and blanchers for use in nut and food processing are included. Also contained are data on digesters, centri-cleaners, double and single disc refiners, pump-through refiners, and pressafiners for pulp, paper, and board mills.

Chemical Loaded Molecular Sieves

Linde Company, Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N.Y. — This new six-page, two-color, booklet explains how chemicals are stored in molecular sieves, indicates the various established uses of this ability and the sorts of chemicals than can be loaded, outlines a typical case history and shows how extremely volatile di-tertiary butyl peroxide was loaded to advantage as a catalyst in the manufacture of vinyl-containing silicone rubber. Also suggested, in general terms, are other uses for chemical-loaded molecular sieves. A questionnaire through which additional data can be obtained is also included at the end of the booklet.

(Continued on page 639)



NEW BOOKS

Handbook of Area Sampling, by John Monroe and A. L. Finkner. 64 pages. Published by Chilton Co., Book Div., 56th and Chestnut Sts., Philadelphia 39, Pa. $3.00.

The threefold purpose of this book is: (1) to bring together the various definitions and procedures involved in the construction of an area frame; (2) to illustrate the use of the frame in drawing a random sample; and (3) to show the adaptability of the materials to several commonly used sample designs.

Sprinkler Irrigation, Second Edition. Edited by Guy Woodward. Cloth. 6 x 9 in. 400 pages. Copies may be obtained from Sprinkler Irrigation Association, 1028 Connecticut Ave., N.W., Washington 6, D.C. $8.50 in the U.S., its territories and possessions, and $9.00 in foreign countries.

This textbook is a compilation of the most recent authoritative information on sprinkler irrigation. It contains 210 pages of text, 65 pages of tables, 104 pages of illustrations, with 26 halftones and 119 charts and graphs.

Aluminum Construction Manual. 6 x 9 in. 390 pages. Copies may be obtained from The Aluminum Association, 420 Lexington Ave., New York 17, N. Y. $3.00.

This is a reference book written for engineers, designers, architects, and students concerned with the use of aluminum in stressed structures, and includes allowable load data for aluminum alloy 6061-T6. The contents are arranged in five parts: Part one gives dimensions, weights and properties of aluminum structural shapes; part two covers detailing practice and data on riveted and bolted connections; part three covers the material for beams and columns produced in alloy 6061-T6; part four presents data on nine alloys which fulfill most structural needs; and part five is devoted to miscellaneous reference data commonly required by practicing engineers and designers.

Symposium on Materials Research Frontiers. Cloth. 6 x 9 in. 48 pages. Copies may be obtained from American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.00.

The symposium was sponsored by the ASTM Administrative Committee on Research and the New England District Council of ASTM and was presented at the 61st Annual Meeting in Boston, June 1958. The following subjects are included: Tailoring the properties of materials; materials in the nuclear age; modern liquid fuels; new advances in physical metallurgy; and recent developments in glass research.

1958 ASTM Proceedings, Vol. 58. 1430 pages. Available at the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $12.00.

This volume, recording the technical accomplishments of the American Society for Testing Materials for the year 1958, includes reports and papers together with discussion offered to the society during the year and accepted for the Proceedings, together with the summary of proceedings of the ASTM 61st Annual Meeting, listing by title and author the programs for each session. Included are 74 reports of technical committees and 51 technical papers and discussions, on a wide variety of subjects pertaining to research and testing materials. Also listed are all symposia and other special sessions published separately as Special Technical Publications, and all papers published in the ASTM Bulletin. An adjunct to the Proceedings is a Subject and Author Index to all papers published in any form by ASTM in 1958.

Successful Technical Writing: Technical Articles, Papers, Reports, Instruction and Training Manuals and Books, by Tyler G. Hicks. 5⅜ x 8 in. 287 pages. 30 illustrations. Published by McGraw-Hill Book Co., Inc., 327 W. 41st St., New York 36, N. Y. $5.50.

In this book, step-by-step guidance in all phases of technical, engineering, and scientific writing is given, for men who have never written before, as well as by established technical writers who wish to improve their skill. How to go about a writing job is explained in detail; also, where to look for ideas, how to evaluate them, how to build an idea into an outline, how to write up the idea, and how to work with editors and publishers in getting the idea into print. In addition to sections on technical articles, reports, papers and books, including textbooks and handbooks, it also gives material on military and industrial training manuals and industrial advertising. Much practical working information is included, as well as examples from actual published material. The book is arranged in a logical manner, starting with the simplest writing job and advancing to the most difficult.

RESEARCH NOTES

Brief news notes and reports on research activities of special agricultural-engineering interest are invited for publication under this heading. These may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Michigan.

Attend Fort Collins Meeting

Norman C. Teter, Willis F. Edgerley, Richard H. Rule, W. Russell Parker, and Robert O. Gilden attended a meeting of the Western Plan Exchange Committee of the Cooperative Farm Building Plan Exchange at Fort Collins, Colo., July 13-17.

The Committee, representing 11 western states and USDA's Agricultural Research Service and the Federal Extension Service reviewed progress in preparing farm house and service building plans this year and planned work for next year.

Mr. Teter, head of the section, Mr. Edgerley, and Mr. Rule are in the Livestock Engineering and Farm Structures Research Branch of the Agricultural Engineering Research Division of ARS. Mr. Parker is a joint employee of the Clothing and Housing Division of the Institute of Home Economics of ARS, and AERD. All are stationed at Beltsville, Md. Mr. Gilden is stationed in Washington with the Federal Extension Service.

Liljedahl Transfers to Beltsville

Louis A. Liljedahl, engineer of USDA's Agricultural Research Service, has transferred from St. Paul, Minn., to headquarters of the Agricultural Engineering Research Division of ARS at Beltsville, Md.

His new work with the Crop Production Engineering Research Branch of AERD includes the development of pesticide application, tillage, planting, and fertilizing equipment.

At St. Paul, he did considerable work on automatic tractor steering devices, on which he reported at the December 1958 meeting of ASAE, and on weed control.

New Federal-State Publications Available

Eight new publications prepared by USDA-State researchers are available, according to the Agricultural Engineering Research Division of USDA's Agricultural Research Service.

The titles and authors are: Lightning Protection for the Farm (USDA Farmers' Bulletin No. 2136) by Harry L. Garver (retired); Rope on the Farm (USDA Farmers' Bulletin No. 2130) by J. Robert McCalmont; Seed-Cotton Input Control for Gins (USDA Production Research Report No. 29) by A. Clyde Griffin, Jr., and Oliver L. McCaskill; Harvesting Blueberries Mechanically, and Experiments in Harvesting Cherries Mechanically (reprints of research reports) by Scott L. Hedden, Harold P. Gaston, and Jordan H. Levin.

A Brighter Future for Cotton (reprint of article) by Rex F. Colwick, and Pallet Bins for Harvesting and Handling Apples (Washington Agricultural Experiment Stations Circular 335) by Stanley W. McBirney and Archie Van Doren. A new building plan description, Farm Cottage, of the Cooperative Farm Building Plan Exchange (Miscellaneous Publication No. 795) also is available.

Farmers' Bulletins 2136 and 2130 and Production Research Report No. 29 may be obtained from the Information Division, Agricultural Research Service, U.S. Department of Agriculture, Washington 25, D. C. The reprints are available from the Harvesting and Farm Processing Research Branch of AERD at Beltsville, Md.

Stations Circular 355 is available at the Washington Agricultural Experiment Station, Pullman, Wash. Miscellaneous Publication 795 may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C., for 5 cents.

Ahrens Now Assistant Branch Chief in AERD

M. Conner Ahrens, engineer of USDA's Agricultural Research Service, is now stationed at Beltsville, Md., as assistant chief of the Farm Electrification Research Branch, Agricultural Engineering Research Division, ARS.

He was stationed at Pullman, Wash., as project director of cooperative AERD-Washington Agricultural Experiment Station investigations. Mr. Ahrens has been with FERB since June 1949.

He conducted research on walk-in freezers, particularly the development of a package-unit freezer. He also developed a method of using heat given off by milk during cooling to preheat water for washing milking utensils and heating the milk house or milking parlor.

New Report on Cotton Planting Rate

A new research report, Cotton Planting Rate Studies on the High Plains, is available. Experiments enabling the report were conducted cooperatively by researchers of the Texas Agricultural Experiment Station and USDA.

The report contains a discussion of the relationship of planting rate to emergence, yield, lint percent, boll size, earliness, weed population, influence on stripper efficiency, plant characteristics, weight of plant parts, water use, and effect on fiber properties. A discussion on application of the findings to farm practices is included.

Authors of the publication are L. L. Ray of the Texas Station, E. B. Hudspeth, and E. R. Holekamp of the Harvesting and Farm Processing Research Branch, Agricultural Engineering Research Division, Agricultural Research Service, USDA, and the Texas Station. The publication, MP-358, may be obtained from the Texas Agricultural Experiment Station, College Station, Texas.

Explains Separation of Pigweed-Alfalfa Seed

Jesse E. Harmond, engineer of USDA's Agricultural Research Service at Corvallis, Ore., recently reported that pigweed seed and alfalfa seed were separated efficiently with a modified indent cylinder-type machine.

Contamination of alfalfa by pigweed, well known as a major problem of farmers and seed processors, costs millions of dollars a year.

A reprint of Mr. Harmond's report will be mailed on request by the Harvesting and Farm Processing Research Branch, Agricultural Engineering Research Division, USDA Plant Industry Station, Beltsville, Md.

PERSONNEL SERVICE BULLETIN

PERSONNEL SERVICE BULLETIN

Note: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listing.

Positions Open—May—O-77-914, 49-915, 97-919. **June**—O-124-920, 131-922, 132-923, 111-924, 135-926, 136-927, 137-928, 140-929, 140-930. **July**—O-170-931, 177-932, 186-933. **August**—O-214-935, 215-936, 216-937, 217-938, 218-939, 212-940, 220-941, 223-942, 228-943, 228-944, 231-946, 231-947, 231-948, 247-949, 259-950, 259-951. **September**—O-265-952, 234-953, 219-954, 264-955, 275-956, 285-957, 277-958, 286-959.

Positions Wanted—May—W-83-15, 84-16, 80-19, 98-20, 100-22. **June**—W-103-25, 104-26, 118-27, 112-28, 123-29. **July**—W-154-31, 178-32, 196-33, 190-34. **August**—W-199-35, 210-36, 224-37. **September**—W-249-40, 258-41, 245-43, 267-44, 269-45, 270-46.

NEW POSITIONS OPEN

Agricultural Engineers (several) for design and development work on agricultural and industrial tractor product design with major manufacturer in Midwest. Age under 40. BSAE or BSME, with emphasis on mechanical design and development. Experience on agricultural and industrial tractor product design desirable. Excellent opportunity for advancement with large progressive organization offering excellent working conditions and supporting facilities to aid in design and development. Salary open. O-315-960

Agricultural Engineer for extension work in farm electrification. Must have at least BS degree in agricultural, electrical, or mechanical engineering. Opportunity to work for advanced degree. Job will involve working with county agent system, private and co-op power suppliers. Age, preferably not over 40. Midwestern University, excellent salary, retirement and fringe benefits. Employment on annual basis with one month's vacation. Apply by letter, including transcript, personal data and snapshot, employment and experience record. O-323-961

Agricultural Engineer for extension work in soil and water utilization. Must have at least a BS degree in civil engineering, professional registration desirable. Opportunity to work for advanced degree. Job will involve working with county agent system, and other extension activities. Age, preferably not over 40 years. Teach one course in soil and water conservation. Midwestern University, excellent salary, retirement and fringe benefits. Employment on annual basis with one month's vacation. Apply by letter, including transcript, personal data and snapshot, employment and experience record. O-323-962

Design Engineer for research, design, and development of farmstead equipment, with emphasis on material handling, with established manufacturer in Midwest. BSAE, BSME, or equivalent experience. Usual personal qualifications for commercial design and development. Must be creative and able to investigate and develop new theories. Opportunity for advancement commensurate with ability. Salary open. O-324-963

NEW POSITIONS WANTED

Agricultural Engineer for design, development, research, writing, or management in power and machinery or product processing with industry or public service. Midwest or West. Married. Age 33. No disability. BSAE, 1951, University of Nebraska. Experience as electrical power use advisor 5 years; plant engineer with canning company over 3 years. Related experience in rural group leadership. Non-commissioned service in Army 1½ years. Available on reasonable notice. Salary open. W-307-47

Agricultural Engineer for design, development, or research with manufacturer or processor in Midwest. Married. Age 35. Corrected vision. BSAE, 1950, Kansas State University. Experience 6 years in design of farm structures; 3 years as maintenance engineer in farm equipment fleet operations of canning company. Several months in machine design with same company. Available on 30 days notice. Salary open. W-297-48.

Agricultural Engineer for design in power and machinery with manufacturer, anywhere in USA. Married. Age 36. No disability. Experience 4 years in combine design; 3 years in mower design. Army service 2 years in Signal Corps. Available on 2 weeks notice. Salary open. W-321-49

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Brubaker, John E.—Agr. eng. ext. spec., Ontario Dept. of Agr., Royal Bank Bldg., St. Thomas, Ont., Canada

Cayton, David W.—Jr. des. engr., John Deere Killefer Works, 5401 Downey Rd., Los Angeles, 58, Calif.

Chesson, Sherwood W.—Sales trainee, John Deere Co. (Mail) Box 486, Monroe, Ga.

Gwinn, Wendell R.—Asst. proj. supervisor, (SCS) (ARS) USDA. (Mail) 906 S. Kings Highway, Stillwater, Okla.

Hough, Richard W.—Gen. supervisor, International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

Ivarson, Harold A.—Sales rep., Link-Belt Co. (Mail) 2118 Thrush St., N.W., Coon Rapids, Minn.

King, Hosmer T.—Vice-pres. and gen. sales mgr., Southeast Ford Tractor Co. (Mail) P.O. Box 755, Decatur, Ga.

McLamb, Harold D.—Mgr. trainee, Martin F.C.X., Williamston, N. C.

Melos, Norman R. — Pres., Melos Mfg. Co. (Mail) 703 Forest Goode Dr., Des Moines, Iowa

Moore, Milo J.—Instructor, agr. eng. dept., The Pennsylvania State Univ., University Park, Pa.

Mortensen, Merton H.—Dairy spec., R. M. Wade & Co., 1919 N.W. Thurman St., Portland, Ore.

Nold, Francis—Owner, Nold Farm Supply, Rome, N. Y.

Padget, John R.—Product engr., J. I. Case Co. (Mail) Mounted Route, Bettendorf, Iowa

Paugh, Ronald L.—Illuminating engr., large lamp dept., General Electric Co., Nela Park, Cleveland 12, Ohio

Pichon, James D.—Instructor in agr. eng., agr. eng. dept., University of Nebraska, Lincoln, Nebr.

Snow, Gilbert R. — Dist. serv. supervisor, International Harvester Co., 812 E. Second St., Little Rock, Ark.

von Wolffradt, Donald B.—Agr. engr., (SCS) USDA (Mail) R.R. 2, Athens, Pa.

Wagner, C. Russell—Hydraulic engr., Water Recourses Div., U.S. Geological Survey. (Mail) 375 Stone Quarry Rd., Ithaca, N. Y.

(Continued on page 639)

. . . Manufacturers' Literature

(Continued from page 631)

Building "Plan Service" Series

Inland Steel Products Co., 4157 W. Burnham St., Milwaukee 1, Wis. — The Plan Service prepared by H. J. Barre, agricultural engineering consultant, includes: Simplified floor plans tested on the farm; things a farmer should think about before he builds — such as selecting proper building locations; and how to figure the size of the building needed to do a specific job. Sets of plans are available in four categories: Machinery Storage (Set LFP-A); Beef Cattle Housing (Set LFP-B); Dairy Cattle Housing (Set LFP-C); and Housing for Hogs, Sheep and Poultry (Set LFP-D). Sets may be obtained at 25c each.

Dairyman's Guide Book

Chore-Boy Manufacturing Co., Inc., Cambridge City, Ind. A 40-page Dairyman's Guide Book — for profitable dairying — compiled, edited, and produced by the company's Farm Economics Research Institute. Sections are devoted to time study, economics, barn layouts, plans for 50, 75 and 100-cow loose housing systems, corral loose housing, cow pools, milking parlor plans, feeding systems and a good selection of useful information for those responsible for dairy housing and milking operations.

Steel Equipment Manual

Equipto, Aurora, Ill. — New 1959-60 reference manual for steel equipment is a 64-page guide. New subjects covered in this edition include slotted angle, mezzanine and floor grating, shelf filing, and large drawer units, as well as the shelving, lockers, work benches, carts, and other storage equipment shown in previous issues.

Wall Chart of Conversion Factors

Precision Equipment Co., 4411 E. Ravenswood Ave., Chicago 40, Ill. — This Conversion Chart is useful for engineers, shop men, and other executives. Included are common conversions such as inches to centimeters or watts to hp, as well as many conversions that are difficult to locate in reference manuals. Some such examples are difficult to locate in reference manuals. atmospheres to Kgs/sq cm, cm/sec to miles/hr, cu ft to liters, microns to meters, quintal to lbs, etc.

Pumps

Hypro Engineering, Inc., Customer Service Dept., 700 39th Ave., N.E., Minneapolis 21, Minn. — Twelve-page, two-color bulletin, entitled "Choosing and Using Hypro Pumps," contains information on pressure and suction problems, tells how to select the proper size motor for various pumps and pumping applications, and lists typical jobs that can be performed. Accessories commonly used in pumping installations are also described.

Polydyne Drives

General Electric Co., Schenectady 5, N. Y. —Bulletin No. GEA-6806, 16 pages, two-colors, illustrates and describes the new ¼ to 25 hp line of Polydyne mechanical adjustable speed drives. Also discussed are the principles of operation, configurations and features; also mounting positions, rating tables, and description of available accessories. How to select and specify the units and the benefits of mechanical adjustable speed drives are also included.

Self-Propelled Hay Baler

New Holland Machine Co., New Holland, Pa. — A four-color brochure describing the company's No. 178 self-propelled baler. This folder describes the features of the new baler including a cruise-control center which puts all controls within reach of the seated operator, variable-speed drive which gives a choice of three speeds forward and one reverse, hydraformatic bale tension that controls bale density and weight, and flow-action feeding for gentle hay handling.

Aluminum Roofing and Siding

Kaiser Aluminum & Chemical Sales, Inc., Agricultural Research Service, 919 N. Michigan Ave., Chicago 11, Ill. — A complete file on the company's aluminum roofing and siding with its applications to agricultural requirements, including a catalog on pole-type building and plans, and a comprehensive roofing and siding guide.

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(Continued from page 637)

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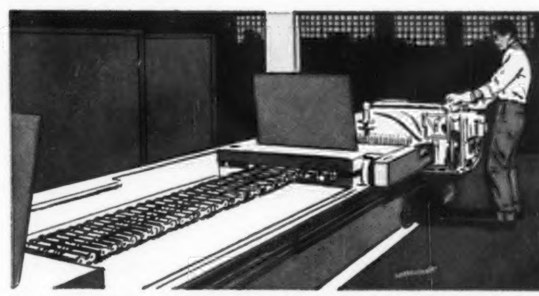

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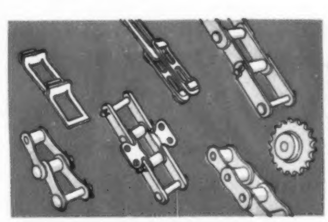

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